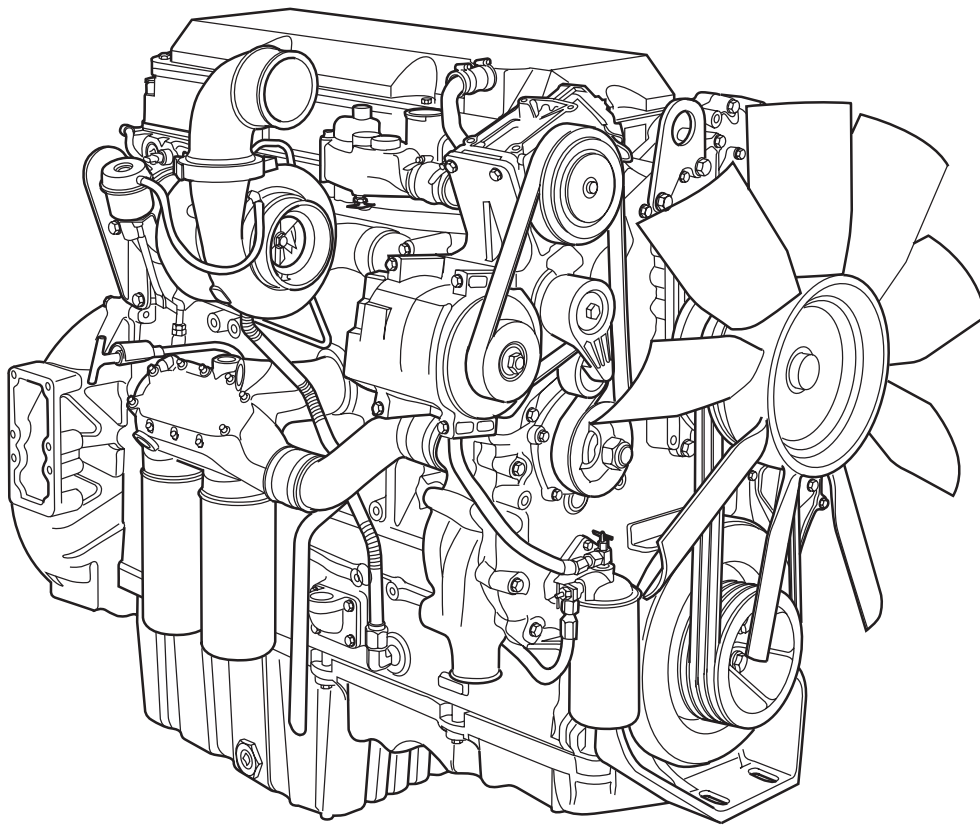


DETROIT DIESEL

Series 60



Engine Operator's Guide

CALIFORNIA

Proposition 65 Warning

Diesel Engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects and other reproductive harm.

To the Operator

This guide contains instructions on the safe operation and preventive maintenance of your Detroit Diesel Series 60 engine used in vehicle, stationary, construction/industrial, agricultural, generator set or fire fighting apparatus applications. Maintenance instructions cover routine engine services such as lube oil and filter changes in enough detail to permit self-servicing, if desired.

The operator should become familiar with the contents of this guide before operating the engine or carrying out maintenance procedures.

Power-driven equipment is only as safe as the person operating the controls. You are urged, as the operator of this diesel engine, to keep fingers and clothing away from the revolving belts, drive shafts, etc. on the engine installation.

Throughout this guide **CAUTIONS** regarding personal safety and

NOTICES regarding engine performance or service life will appear. To avoid personal injury and ensure long engine service life, always heed these instructions.

Whenever possible, it will benefit you to rely on an authorized Detroit Diesel service outlet for all your service needs from maintenance to major parts replacement. Authorized service outlets worldwide stock factory original parts and have the specialized equipment and experienced, trained personnel to provide prompt preventive maintenance and skilled engine repairs.

The information and specifications in this publication are based on the information in effect at the time of approval for printing. Contact an authorized Detroit Diesel service outlet for information on the latest revision. The right is reserved to make changes at any time without obligation.

NOTICE:

Coolant *must* be inhibited with the recommended SCA's (supplemental coolant additives) listed in the "How to Select Coolant" section of this engine operator's guide. In addition, the engine can be equipped with a coolant filter/inhibitor system as an installed option or as an after-sale item. Failure to check and maintain SCA levels at required concentrations will result in severe damage (corrosion) to the engine cooling system and related components.

WARRANTY

The applicable engine warranty is contained in the booklet entitled "Warranty Information for Series 60 Engines," available from authorized Detroit Diesel service outlets.

Keep this Operators Guide with the engine installation at all times. It contains important operating, maintenance, and safety instructions.

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INTRODUCTION

This guide is intended for use by the operator of a Detroit Diesel Series 60® engine used in the following applications:

- On-Highway Vehicles
- Fire Truck or Crash/Rescue Vehicles
- Construction/Industrial
- Agricultural Machinery
- Generator Drive Engine

Operators of Series 60 marine engines should refer to the Detroit Diesel *Series 60 Marine Engine Operator's Guide*, 6SE559. Operators of Series 60 engines used in prime power or stand-by generator set applications should also refer to the Detroit Diesel *Generator Set Operator's Guide*, 6SE513. Guides are available from authorized Detroit Diesel distributors.

NON-GENUINE AND REBUILT COMPONENT QUALITY ALERT

In recent years, electronic engine controls have been instrumental in aiding engine manufacturers in meeting the stringent emission requirements of the U.S. Environmental Protection Agency (U.S. EPA) and the California Air Resources Board (CARB) and also meeting the ever-increasing performance demands of the customer. Proper engine maintenance by the owner or operator ensures that the control system will meet such emission and performance standards.

Maintenance procedures are to be followed in order to continue satisfactory performance and durability and to ensure coverage of the engine under the manufacturer's warranty. Many of these maintenance procedures also ensure that the engine continues to comply with applicable emissions standards. The U.S. EPA specifically defines an engine's "useful emission life" – currently established as 290,000 miles for on-highway engines. Proper maintenance procedures, using specific components engineered to comply with emissions regulations, may be performed by an authorized Detroit Diesel distributor or dealer, an independent outlet or the operator or owner. The owner is responsible for determining the suitability of components to maintain emissions compliance during the engine's useful emission life.

Electronic controls and components have significantly increased in sophistication, but the fundamental objective remains the same – precise timing and delivery of fuel. The very heart of the Detroit Diesel Electronic Controls is the Electronic Unit Injector (EUI). The proper functioning of the EUI is absolutely paramount if the benefits of electronic controls are to be realized. Detroit Diesel Corporation has built over 500,000 engines with electronic unit injectors – more than anyone else in the business. Detroit Diesel cautions that the indiscriminate rebuilding of precision components, without the benefit of specifications, specialized equipment, and knowledge of the electronic operating system, will jeopardize performance or lead to more serious problems, and can take the engine outside of compliance with EPA or California emissions standards.


There are other components in an engine, such as turbocharger, camshaft, piston, etc., which are specifically designed and manufactured to exacting standards for emissions compliance. It is important that these components, if replaced, modified or substituted, can be verified to ensure that the engine remains in compliance with emissions standards. The use of inadequately engineered, manufactured or tested components in repair or rebuild of the engine may be in violation of the federal Clean Air Act and applicable U.S. EPA or CARB regulations.


Furthermore, modern engines exhibit operating parameters which require the use of proper fluids such as fuel, coolant and lubricating oil to maintain long engine life. The use of fluids that do not meet Detroit Diesel Corporation specifications may result in early wear out or engine failure.


CAUTION SUMMARY


The following cautions must be observed by the operator of the vehicle or equipment in which this engine is installed and/or by those performing basic engine preventive maintenance. Failure to read and heed these cautions and exercise reasonable care for personal safety and the safety of others when operating the vehicle/equipment or performing basic engine preventive maintenance may result in personal injury and engine and/or vehicle/equipment damage.

1. Observe the following cautions when operating the engine:


	CAUTION:
Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects and other reproductive harm.	
■ Always start and operate the engine in a well-ventilated area.	
■ If operating the engine in an enclosed area, vent the exhaust to the outside.	
■ Do not modify or tamper with the exhaust system or emission control system.	


	CAUTION:
To avoid injury from engine shut-down in an unsafe situation, ensure the operator knows how to override the stop engine condition on a DDEC-equipped unit.	


	CAUTION:
To avoid injury from loss of vehicle/vessel control, the operator of a DDEC equipped engine must not attempt to use or read the Diagnostic Data Reader when the vehicle/vessel is moving.	


	CAUTION:
To avoid injury from the loss of vehicle control, do not use cruise control under these conditions:	
■ When it is not possible to keep the vehicle at a constant speed (on winding roads, in heavy traffic, in traffic that varies in speed, etc.).	
■ On slippery roads (wet pavement, ice or snow-covered roads, loose gravel, etc.).	


2. Observe the following cautions when performing basic preventive maintenance on the engine:


	CAUTION:
To avoid injury when working near or on an operating engine, remove loose items of clothing, jewelry, and tie back or contain long hair that could be caught in any moving part, causing injury.	


	CAUTION:
To avoid injury from hot oil, do not operate the engine with the rocker cover(s) removed.	


	CAUTION:
To avoid injury from fire, contain and eliminate leaks of flammable fluids as they occur. Failure to eliminate leaks could result in fire.	


	CAUTION:
To avoid injury from contact with the contaminants in used engine oil, wear protective gloves and apron.	


	CAUTION:
To avoid injury from fire caused by heated lubricating-oil vapors:	
<ul style="list-style-type: none"> ■ Keep those people who are not directly involved in servicing away from the engine. ■ Stop the engine immediately if an oil leak is detected. ■ Do not allow open flames or smoke when working on an operating engine. ■ Wear adequate protective clothing (face shield, insulated gloves, apron, etc.) to avoid burns. ■ To prevent a buildup of potentially volatile vapors, keep the engine area well ventilated during operation. 	
Lubricating oil is relatively harmless at ambient temperatures.	


	CAUTION:
To avoid injury from slipping and falling, immediately clean up any spilled liquids.	

	CAUTION:
To avoid injury from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Remove the cap slowly to relieve pressure. Wear adequate protective clothing (face shield or safety goggles, rubber gloves, apron, and boots).	


	CAUTION:
To avoid injury from burns, shut down the engine and allow it to cool to ambient temperature before performing basic preventive maintenance.	


	CAUTION:
To avoid injury from the protection of tools or other objects that may fall on or behind the vibration damper of an engine, always check and remove these items before starting the engine.	

	CAUTION:
<p>To avoid injury from contact with rotating parts when an engine is operating with the air inlet piping removed, install an air inlet screen shield over the turbocharger air inlet. The shield prevents contact with rotating parts.</p>	


	CAUTION:
<p>To avoid injury when using caustic cleaning agents, follow the chemical manufacturers usage, disposal, and safety instructions.</p>	

3. Observe the following cautions when using compressed air:


	CAUTION:
<p>To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 40 psi (276 kPa) air pressure.</p>	


	CAUTION:
<p>Do not apply compressed air to any part of the body or clothing. Compressed air directed at the face or body may cause eye or hearing injury or other serious physical injury.</p>	


4. Observe the following caution when using starting aids:

	CAUTION:
<p>To avoid personal injury when using ether during an engine startup, ensure to follow these precautions:</p> <ul style="list-style-type: none"> ■ Do not smoke when servicing ether system. ■ Work in well-ventilated area. ■ Do not work near open flames, pilot flames (gas or oil heaters), or sparks. ■ Do not weld or carry an open flame near the ether system if you smell ether or otherwise suspect a leak. ■ Always wear goggles when testing. ■ Opening in the valve, tube, or nozzle (nozzle opening indicated by red dot) must be pointed away from you when testing. ■ The engine starting fluid used in DDEC® Ether Start Systems contains ethyl ether and is extremely flammable and toxic. It can be harmful or fatal if swallowed. Avoid contact with skin or eyes. Avoid breathing fumes. If swallowed, DO NOT INDUCE VOMITING. Call a physician immediately. ■ If fluid enters the eyes or if fumes irritate the eyes, wash eyes with large quantities of clean water for 15 minutes. A physician, preferably an eye specialist, should be contacted. ■ Contents of cylinder are under pressure. Store cylinders in a cool dry area. Do not incinerate, puncture or attempt to remove cores from cylinders. 	


5. Observe the following cautions when jump starting an engine, charging a battery, or working with the vehicle electrical system:


	CAUTION:
To avoid injury from accidental engine startup while servicing the engine, disconnect/disable the starting system.	


	CAUTION:
To avoid injury from battery explosion or contact with battery acid, work in a well-ventilated area, wear protective clothing, and avoid sparks or flames near the battery. Always establish correct polarity before connecting cables to the battery or battery circuit. If you come in contact with battery acid:	
<ul style="list-style-type: none"> ■ Flush your skin with water. ■ Apply baking soda or lime to help neutralize the acid. ■ Flush your eyes with water. ■ Get medical attention immediately. 	


	CAUTION:
To avoid injury from electrical shock, do not touch battery terminals, alternator terminals, or wiring cables while the engine is operating.	

6. Observe the following cautions when fueling the vehicle, replacing fuel filters or working with the engine fuel system:


	CAUTION:
The addition of gasoline to diesel fuel will create a serious fire hazard. Do not mix gasoline with diesel fuel.	


	CAUTION:
To avoid injury from fire, keep all potential ignition sources away from diesel fuel, including open flames, sparks, and electrical resistance heating elements. Do not smoke when refueling.	

	CAUTION:
To avoid injury from fire caused by heated diesel-fuel vapors:	
<ul style="list-style-type: none"> ■ Keep those people who are not directly involved in servicing away from the engine. ■ Stop the engine immediately if a fuel leak is detected. ■ Do not allow open flames or smoke when working on an operating engine. ■ Wear adequate protective clothing (face shield, insulated gloves and apron, etc.). ■ To prevent a buildup of potentially volatile vapors, keep the engine area well ventilated during operation. 	
Diesel fuel is relatively harmless at ambient temperatures.	


	CAUTION:
To avoid injury from fire, contain and eliminate leaks of flammable fluids as they occur. Failure to eliminate leaks could result in fire.	


7. Observe the following cautions when servicing the cooling system:

	CAUTION:
To avoid injury from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Remove the cap slowly to relieve pressure. Wear adequate protective clothing (face shield or safety goggles, rubber gloves, apron, and boots).	


	CAUTION:
To avoid injury from slipping and falling, immediately clean up any spilled liquids.	


8. Observe the following cautions when working on the engine air intake system:

	CAUTION:
To avoid injury from hot surfaces, allow engine to cool before removing any component. Wear protective gloves.	

	CAUTION:
To avoid injury from contact with rotating parts when an engine is operating with the air inlet piping removed, install an air inlet screen shield over the turbocharger air inlet. The shield prevents contact with rotating parts.	

9. Observe the following cautions when replacing the engine lubricating oil and filters:

	CAUTION:
To avoid injury from fire caused by heated lubricating-oil vapors:	
<ul style="list-style-type: none"> ■ Keep those people who are not directly involved in servicing away from the engine. ■ Stop the engine immediately if an oil leak is detected. ■ Do not allow open flames or smoke when working on an operating engine. ■ Wear adequate protective clothing (face shield, insulated gloves, apron, etc.) to avoid burns. ■ To prevent a buildup of potentially volatile vapors, keep the engine area well ventilated during operation. 	
Lubricating oil is relatively harmless at ambient temperatures.	

	CAUTION:
To avoid injury from slipping and falling, immediately clean up any spilled liquids.	

ENGINE MODEL AND SERIAL NUMBER DESIGNATION

The engine serial number and model number are stamped on the cylinder block in the following location (as viewed from the flywheel end):

Left side just below the intake manifold and above the cast-in Detroit Diesel logo. See Figure 1.

Option Labels

Computerized engine option labels are attached to the valve rocker cover. These labels contain the engine serial number and model number and, in addition, list any optional equipment used on the engine. Labels also include required tune-up information (injection timing, valve lash, max. no-load RPM, etc.). See Figure 2.

With any order for parts, the engine model and serial number must be given. If a type number is shown on the option label covering the equipment required, this number should also be included on the parts order.

Transmissions and power take-offs generally carry their own name plates. The model and serial number information on these plates is useful when ordering parts for these assemblies.

Certification Labels

If required, a certification label is attached to the valve rocker cover. This label certifies that the engine conforms to federal and certain state emissions regulations for its particular application. It also gives the operating conditions under which certification was made. See Figure 2.

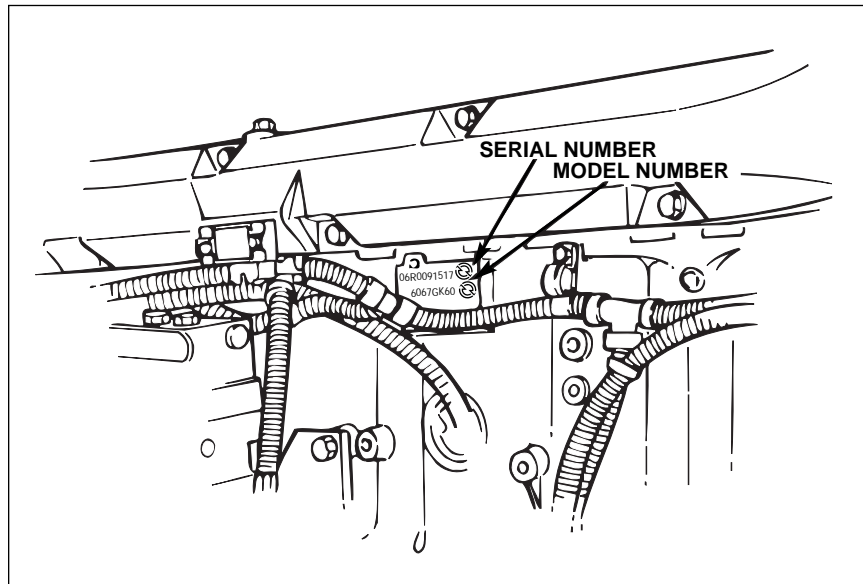




Figure 1. Location of Engine Serial and Model Numbers

0262 FUEL PUMP	2261 GEN MOUNT	0688 INJ CONT ELEC
0409 INJECTOR	1405 OIL COOLER	0594 OIL DIST
0638 OIL FILTER	0919 OIL PAN	0169 OILFILSHPGONL
0444 PWR STR ADAP	0445 PWR STR ADAPT	0583 ROCKER COVER
0358 THERMOSTAT	1743 TURBOCHARGER	0650 VALVE MECH
0893 VENT SYSTEM	1072 VENT SYSTEM	0161 VIB DAMPER
0464 WAT BYPASS	0459 WATER CONN	0306 WATER PUMP



UNIT 06R0_____ S.O._____ MODEL 606_____ SPEC._____


EER 14B07	0438 ACC DRIVE	THIS ENGINE WAS
1404 AIR COMP	0028 AIR INTK MFLD	TESTED AT 430 HP
0178 C/S COVER	0387 C/S PULLEY	AT 2100 RPM
0693 CONN ROD/PSTN	0131 CRANKSHAFT	INJ. SETTING 81.0 MM
0566 CYL BLOCK	1448 DIPSTICK	VALVE LASH
0260 ENG LIFT BRKT	0765 ENGINE MOUNTS	EXHAUST .660 MM
0715 EXH MANIFOLD	0871 F/W HOUSING	INTAKE .203 MM
1758 FAN MOUNTS	1260 FLYWHEEL	MAX RPM NL 2225
0840 FUEL FILTER	2126 FUEL LINES	STD CAM TIMING



UNIT 06R0_____ S.O._____ MODEL 606_____ SPEC._____


THIS ENGINE IS NOT CERTIFIED FOR USE IN AN URBAN BUS AS DEFINED AT 40 CFR 86.093 2. SALE OF THIS ENGINE FOR USE IN AN URBAN BUS IS A VIOLATION OF FEDERAL LAW UNDER THE CLEAN AIR ACT.

THIS ENGINE IS CERTIFIED TO OPERATE ON LOW SULFUR DIESEL FUEL.



UNIT 06R0_____

1999	IMPORTANT ENGINE INFORMATION
50S	THIS ENGINE CONFORMS TO U.S. EPA AND CALIFORNIA REGULATIONS APPLICABLE TO 1999 MODEL YEAR NEW HEAVY DUTY DIESEL CYCLE ENGINES. THIS ENGINE HAS A PRIMARY INTENDED SERVICE APPLICATION AS A HEAVY HEAVY DUTY ENGINE.
	FUEL RATE AT ADV. HP 250.6 MM3/STROKE ADV. HP 500 AT 2100 RPM
	INITIAL INJECTION TIMING 14 DEG. BTC DISP. 12.7 LITERS
	ENGINE FAMILY XDDXH12.7EGL MIN. IDLE 600 RPM
	MODEL SERIES 60, 12.7 L MFG. DATE DEC 1999
	UNIT 06R0_____ CONFORMS TO AUSTRALIAN DESIGN RULE 30



Option Labels

Certification Labels

Figure 2. Typical Engine Option and Certification Labels

OPERATING INSTRUCTIONS

Preparations for Starting the Engine the First Time

When preparing to start a new or newly overhauled engine or an engine which has been in storage, perform all of the operations listed below. Failure to follow these instructions may result in serious engine damage. Before a routine start, see "Daily" checks in the Engine Maintenance charts (pages 21-25).



CAUTION:

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects and other reproductive harm.

■ **Always start and operate the engine in a well-ventilated area.**

■ **If operating the engine in an enclosed area, vent the exhaust to the outside.**

■ **Do not modify or tamper with the exhaust system or emission control system.**



CAUTION:

To avoid injury when working near or on an operating engine, remove loose items of clothing, jewelry, and tie back or contain long hair that could be caught in any moving part, causing injury.

Cooling System Checks

1. Make sure all the drain cocks in the cooling system are installed (drain

cocks are often removed for shipping) and are closed tightly.

2. Remove the radiator pressure control cap and fill with genuine Detroit Diesel **Power Cool** antifreeze or an equivalent quality ethylene glycol or propylene glycol-base antifreeze solution in the required concentration. In extremely hot environments, clean, soft, **properly inhibited** water may be used in the summer. Keep the coolant level at the bottom of the filler neck to allow for expansion of the coolant. For more detailed coolant recommendations, refer to **How to Select Coolant** (page 48).

3. Entrapped air must be purged after filling the cooling system. To do this, allow the engine to warm-up with the pressure cap off. With the transmission in neutral, increase engine speed above 1,000 RPM and add coolant as required.

4. Check to make sure the front of the radiator and air-to-air charge cooler (if equipped) are unblocked and free of debris.

Lubricating System Checks

The lubricating oil film on the rotating parts and bearings of a new or newly overhauled engine, or one which has been in storage for six months or more, may be insufficient when the engine is started for the first time. Insufficient lubrication at start-up can cause serious damage to engine components.

To insure an immediate flow of oil to all bearing surfaces at initial engine start-up, the engine lubrication system should be charged with a commercially available pressure pre-lubricator. If this is impractical, rocker covers should be removed and clean lubricating oil should be poured over the rocker arms. The oil

should be the same weight and viscosity as that used in the crankcase. After pre-lubricating, add additional oil to bring the level to the proper mark on the dipstick. See Figure 3. Refer to **How to Select Lubricating Oil** (page 38) for lubricant recommendation.

Extended Storage—An engine in storage for an extended period of time (over winter, for example) may accumulate water in the oil pan through normal condensation of moisture (always present in the air) on the cold internal surfaces of the engine. Lube oil diluted by water cannot provide adequate bearing protection at engine startup. For this reason, Detroit Diesel recommends replacing the engine lube oil and filter(s) after extended storage.

NOTICE:
Failure to eliminate water-diluted lube oil may lead to serious engine damage at startup.

Make sure the transmission is filled to the proper level with the fluid recommended by the gear manufacturer.

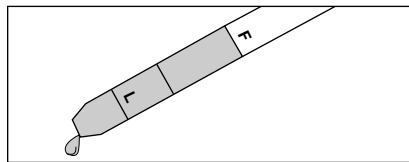


Figure 3. Check Lube Oil Level Before Starting

Fuel System Checks

Fill the tank with the recommended fuel. Keeping tanks full reduces water condensation and helps keep fuel cool, which is important to engine performance. Full tanks also reduce the

chances for microbe (black slime) growth. Refer to **How to Select Fuel Oil** (page 41) for fuel recommendation. Make sure the fuel supply shutoff valve (if used) is open.

To insure prompt starting and even running, the fuel system must be primed if air has entered the fuel system. Priming is done by connecting a manual or electric priming pump to the secondary fuel filter. Authorized Detroit Diesel service outlets are properly equipped to perform this service.

Priming is not normally necessary if the filter elements are filled with fuel when installed and the manifolds are not drained of fuel.

NOTICE:
Prolonged use of the starting motor and engine fuel pump to prime the fuel system can result in damage to the starter, fuel pump, and injectors, and cause erratic engine operation due to the amount of air in the lines and filters from the supply tank to the cylinder head.
Engines equipped with starting devices dependent on compressed air or gas reservoirs should always be primed before initial startup. Otherwise, reserve pressure can be exhausted and injectors may be damaged from lack of lubrication and cooling.
Under no circumstances should a starting aid such as ether be used to run the engine until the fuel system is primed. Injector damage will occur if this method is used. The heat generated by the external fuel source will cause the injector tips to be damaged when the fuel cools them. The plunger and bushing can be scored from running without lubrication.

If the engine is equipped with a fuel/water separator, drain off any water that has accumulated. Water in fuel can seriously affect engine performance and may cause engine damage. Detroit Diesel recommends installation of a fuel/water separator wherever water contamination is a concern.

If a manual transmission is installed, check the oil level. Add required transmission fluid to bring the level to the "full" mark on the dipstick. Do not overfill.

Other Checks

Check drive belts to make sure they are in good condition (not cracked, torn, worn, or glazed) and are properly adjusted.

Make sure cable connections to the storage batteries are clean and tight. Check the hydrometer "eye" of maintenance-free batteries for charge. See Figure 4. If lead-acid or low maintenance batteries are used, make sure battery electrolyte level is normal.

Check turbocharger for signs of oil or exhaust leaks. Leaks should be corrected before starting the engine. Check engine mounting bolts for tightness. Retighten, if necessary.

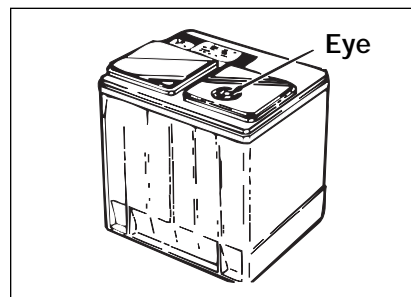



Figure 4. Check "Eye" of Maintenance-Free Batteries

Starting the Engine

Before starting the engine the first time, perform the operations listed under **Preparations for Starting the Engine the First Time** (pages 3-4).

If the engine has an emergency manual or automatic shutdown system, make sure the control is set in the *open* position before starting. The turbocharger may be seriously damaged if the engine is cranked with the air shutdown in the *closed* position.

The engine may require the use of a cold weather starting aid if the ambient temperature is below 40°F (4°C).

	CAUTION:
<p>To avoid personal injury when using ether during an engine startup, ensure to follow these precautions:</p> <ul style="list-style-type: none"> ■ Do not smoke when servicing ether system. ■ Work in well-ventilated area. ■ Do not work near open flames, pilot flames (gas or oil heaters), or sparks, ■ Do not weld or carry an open flame near the ether system if you smell ether or otherwise suspect a leak. ■ Always wear goggles when testing. ■ Opening in the valve, tube, or nozzle (nozzle opening indicated by red dot) must be pointed away from you when testing. ■ The engine starting fluid used in DDEC® Ether Start Systems contains ethyl ether and is extremely flammable and toxic. It can be harmful or fatal if swallowed. Avoid contact with skin or eyes. Avoid breathing fumes. If swallowed, DO NOT INDUCE VOMITING. Call a physician immediately. ■ If fluid enters the eyes or if fumes irritate the eyes, wash eyes with large quantities of clean water for 15 minutes. A physician, preferably an eye specialist, should be contacted. ■ Contents of cylinder are under pressure. Store cylinders in a cool dry area. Do not incinerate, puncture or attempt to remove cores from cylinders. 	

Initial Engine Start

To start a Series 60 DDEC engine be sure the transmission is in neutral or park and turn the ignition key on.

You will notice that both the "Check Engine" and "Stop Engine" lights will come on. See Figure 5. This is the result of the DDEC computer diagnosing the system to ensure everything is functional, including the light bulbs for the "Check Engine" and "Stop Engine" warning lights. If everything is okay, both lights will go out in approximately five seconds.

Start the engine *after* the lights go out. If starting a vehicle, start the engine with foot *off* the foot pedal.

NOTICE:
<p>If the warning lights stay on, consult with a DDEC technician. Operating the engine under these circumstances may result in engine damage.</p>

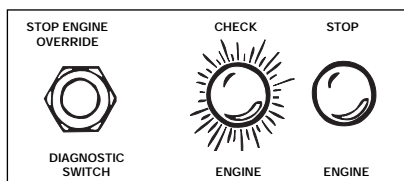


Figure 5. Typical Shut-Down Override Switch and Engine Lights

1. Press the starter switch firmly.

NOTICE:
<p>To prevent serious starting motor damage, do not press the starter switch again after the engine has started.</p>

2. If the engine fails to start within 15 seconds, release the starter switch and allow the starting motor to cool for 15 seconds before trying again. If the engine fails to start after four attempts, an inspection should be made to determine the cause.

Air Starter—Because of the limited volume of most storage tanks and the relatively short duration of the cranking cycle, it is important to **make sure the engine is ready to start before activating the air starter**. Start an engine equipped with an air starter as follows:

1. Check the pressure in the air storage tank. If necessary, add air to bring the pressure up to at least the recommended minimum for starting.
2. With foot OFF the foot pedal, press the starter button firmly and hold until the engine starts.

Running the Engine

Oil Pressure

Observe the oil pressure gauge immediately after starting the engine. A good indicator that all of the moving parts are getting lubrication is when the oil pressure gauge registers pressure (5 psi - 34.5 kPa at idle speed). If there is no oil pressure indicated within 10 to 15 seconds, stop the engine and check the lubricating system. The pressure should not fall below 28 psi (193 kPa) at 1800 rpm, and normal operating pressure should be higher. If pressure does not fall within these guidelines, it should be checked with a manual gauge.



CAUTION:

To avoid injury from hot oil, do not operate the engine with the rocker cover(s) removed.

Warm-up

Run the engine at part throttle for about five (5) minutes to allow it to warm up before applying a load.

Inspection

Transmission—While the engine is idling, check the automatic transmission (if equipped) for proper oil level and add oil as required. Look for coolant, fuel, or lubricating oil leaks at this time. If any are found, shut down the engine immediately and have leaks repaired after the engine has cooled.

Crankcase—If the engine oil was replaced, stop the engine after normal operating temperature has been reached. Allow the oil to drain back into the crankcase for approximately 20 minutes, and check the oil level. If necessary, add oil to bring the level to the proper mark on the dipstick. Use only the heavy-duty oils recommended in **How to Select Lubricating Oil** (page 38) in this guide.

Turbocharger—Make a visual inspection of the turbocharger for oil leaks, exhaust leaks, excessive noise or vibration. Stop the engine immediately if a leak or unusual noise or vibration is noted. **Do not restart the engine until the cause of the concern has been investigated and corrected.** Authorized Detroit Diesel service outlets are properly equipped to perform this service.

Avoid Unnecessary Idling



CAUTION:

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects and other reproductive harm.

■ **Always start and operate the engine in a well-ventilated area.**

■ **If operating the engine in an enclosed area, vent the exhaust to the outside.**

■ **Do not modify or tamper with the exhaust system or emission control system.**

During long engine idling periods with the transmission in neutral, the engine coolant temperature may fall below the normal operating range. The incomplete combustion of fuel in a cold engine will cause crankcase dilution, formation of lacquer or gummy deposits on the valves, pistons, and rings, and rapid accumulation of sludge in the engine. When prolonged idling is necessary, maintain at least 850 rpm spring/summer and 1200 rpm fall/winter.

Stopping the Engine

Normal Stopping

1. Decrease engine speed back to normal idle and put all shift levers in the neutral position.
2. Allow the engine to run between idle and 1000 rpm with no load for four or five minutes. This allows the engine to cool and permits the turbocharger to slow down. After four or five minutes, shut down the engine.

NOTICE:

Stopping a turbocharged engine immediately after high speed operation may cause damage to the turbocharger, as it will continue to turn without an oil supply to the bearings.

Emergency Jump Starting

DDEC III and DDEC IV electronic control systems operate on 12 or 24 volts DC. If a DDEC III or IV engine with an electronic starting motor requires emergency jump starting, do not exceed 32 volts DC.

NOTICE:

Jump starting with voltages greater than those indicated *or* reversing battery polarity may damage the ECM (Electronic Control Module).

Before attempting to jump start the engine, make sure jumper cables are connected properly (positive to positive, negative to negative) and in the proper sequence (negative to negative *last*).

NOTICE:

Failure to observe this precaution can result in alternator and/or equipment damage.



CAUTION:

To avoid injury from battery explosion or contact with battery acid, work in a well-ventilated area, wear protective clothing, and avoid sparks or flames near the battery. Always establish correct polarity before connecting cables to the battery or battery circuit. If you come in contact with battery acid:

- Flush your skin with water.
- Apply baking soda or lime to help neutralize the acid.
- Flush your eyes with water.
- Get medical attention immediately.

DDEC III/IV OPTIONS

Detroit Diesel Series 60 engines equipped with DDEC III or DDEC IV electronic control systems are identified by a "K" in the sixth position of the model number. Example: 6067GK60.

Detroit Diesel Electronic Controlled Series 60 engines can be equipped with a variety of options designed to warn the operator of an engine malfunction. The options can range from "Check Engine" and "Stop Engine" panel lights (see Figure 6) to automatic reduction in engine power followed by automatic engine shutdown. The power-down/shutdown option may be activated by low coolant level, low oil pressure or high engine oil or coolant temperature.

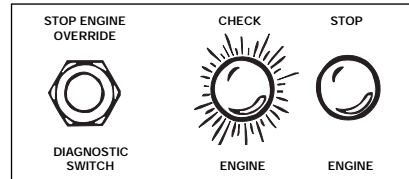


Figure 6. Typical Shut-Down Override Switch and Engine Lights

NOTICE:

If the warning lights stay on, or if they do not come on momentarily after turning on the ignition, consult with a DDEC technician. Operating the engine under these circumstances may result in engine damage.

The Series 60 DDEC engine is equipped with an electronically controlled fuel injection system. There

are no control racks or mechanical linkage to adjust. This system not only helps to improve fuel economy and vehicle performance, it also helps to reduce cold starting time and increase initial idle speed for fast engine warm-up and virtual elimination of cold smoke.

The DDEC engine has no mechanical governor. Engine horsepower, torque, idle, and engine speed are contained in the internal electronics. Therefore, there are no mechanical governor spring adjustments for idle and high speed control.

There is no need for a throttle delay either, since emission control is performed through the Electronic Control Module (ECM).

The Electronic Foot Pedal Assembly (EFPA), eliminates the need for any throttle linkage.

The DDEC engine has the ability to perform diagnostics for self-checks and continuous monitoring of other system components. Depending on the application, DDEC can also monitor oil temperature, coolant temperature, oil pressure, fuel pressure, coolant level, and remote sensors (if used). This diagnostic system is connected to the "Check Engine" light (CEL) and the "Stop Engine" light (SEL) to provide a visual warning of a system malfunction.

The DDEC engine can be equipped with an engine protection system that features a 30 second, stepped-power shutdown sequence or an immediate speed reduction without shutdown in the event a major engine malfunction occurs, such as low oil pressure, high oil or coolant temperature, or low coolant level.



CAUTION:

To avoid injury from engine shutdown in an unsafe situation, ensure the operator knows how to override the stop engine condition on a DDEC-equipped unit.

NOTICE:

If the engine is equipped with the power-down/shutdown option, there will be a system override button or switch which may be used to allow engine operation for a short period of time. If the shutdown override button is not used, the shutdown will occur in 30 seconds. Using the override button so that the engine operates for an extended period may result in engine damage.

The DDEC engine may also have an optional 1-100 minute idle shutdown system. The purpose of this system is to conserve fuel by eliminating excessive idling and to allow for a turbocharger cool down period. To activate the shutdown, the transmission must be in neutral, with the vehicle parking brakes set and with the engine in idle or fast idle mode.

Cruise Control

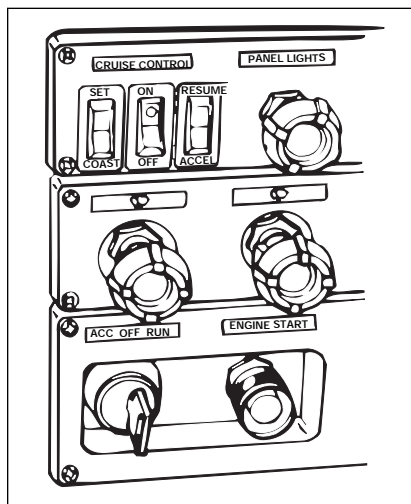


Figure 7. Typical Cruise Control Switches

The DDEC engine may have cruise control. Cruise control maintains a set vehicle or engine speed setting. The driver has switches to set, activate, and deactivate the system. See Figure 7. A slight depression of the brake or clutch pedal deactivates the system as well. The minimum speed at which cruise control can be used is programmable.

The cruise control may also be programmed to permit fast idle using the cruise control switches. With the engine at normal idle, transmission in neutral and service brake on, turn on the cruise control "On/Off" switch, and use the "Resume" switch. The engine rpm should increase to a pre-defined rpm. The rpm can be raised or lowered from this point using the "set" and "resume" switches.

The cruise control option will maintain the set speed under normal road and load conditions. It cannot limit vehicle speeds on down grades if available

engine braking effort is exceeded, nor can it maintain speed on upgrades if power requirements exceed engine power capability.

When the cruise enable switch is in the *on* position cruise control is engaged by momentarily contacting the "Set/Coast" switch to the *on* position. Holding the switch in the *on* position allows the vehicle to slow to a lower speed. Toggling this switch will result in a one mile-per-hour (1 mph) decrease in vehicle speed. If cruise control has been disabled, toggling the "Resume/Accel" switch restores the vehicle to the previously set cruise speed. Holding the "Resume/Accel" switch in the *on* position allows the vehicle speed to increase. Toggling this switch will result in a one mile-per-hour (1 mph) increase in vehicle speed.

Using either the brake or the clutch will disable cruise control.

NOTICE:

When descending a hill with cruise control "off," do not allow the engine to exceed 2,500 rpm under any conditions. Failure to observe this precaution can result in overspeeding and serious engine damage.



CAUTION:

To avoid injury from the loss of vehicle control, do not use cruise control under these conditions:

- When it is not possible to keep the vehicle at a constant speed (on winding roads, in heavy traffic, in traffic that varies in speed, etc.).
- On slippery roads (wet pavement, ice- or snow-covered roads, loose gravel, etc.).

On engines equipped with Jacobs Engine Brakes, the Jake Brakes are enabled by an "On/Off" switch mounted on the dash. A separate intensity switch is used to select *low*, *medium*, or *high* braking power. The engine brake will only operate when the foot pedal is fully released. Disengaging the clutch will prevent the engine brakes from operating, also.

Jake Brakes will supply braking power even when in cruise control. The electronic control module will control the amount of engine brake with respect to the cruise control set speed. The maximum amount of braking (*low*, *medium*, *high*) is selected with the dash switches.

Data Recording Capability

Standard in all DDEC IV engines is a Data Recording capability called DDEC Reports. DDEC Reports contain information on driver activities, engine performance and critical incidents reporting. This information is also available in DDEC III, but must be activated by Detroit Diesel Corporation at the request of the customer. The information in both DDEC III and IV can be extracted with Detroit Diesel Diagnostic Link 2.0 (DDDL 2.0) software. DDEC III information only may be extracted with ProManager 2.0 software. To perform the extraction at least a 486 computer with 16 MB RAM is required.

DDEC III/IV Operation

Since the DDEC system is electronic, a battery is required to operate the computer. The system operates at 12 or 24 volts. However, in the event of a power supply malfunction, the system will continue to operate at reduced voltage. When this occurs the "Check Engine" light will come on. See Figure 8. The engine will only operate at reduced rpm until the battery voltage reaches a point where the ECM I

will no longer function and the engine shuts down.

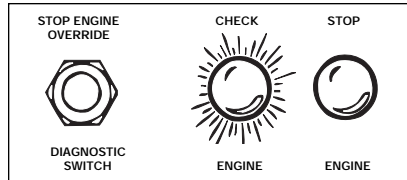


Figure 8. Typical Shut-Down Override Switch and Engine Lights

Should the "Check Engine" light come on for any reason, the vehicle can still be operated and you can proceed to your destination. This condition should be reported to a DDEC technician as soon as possible.

NOTICE:

When the "Stop Engine" light comes on, the computer has detected a major malfunction in the engine that requires immediate attention. It is the operator's responsibility to shut down the engine to avoid serious damage.

The engine can be configured to give a warning only, to ramp down (reduce power), or to shut down. Ramp down will reduce engine rpm to a predetermined speed, but will not shut down the engine. With the 30 second shutdown option the engine will begin a 30 second, stepped, power-down sequence until it shuts down completely. A "Stop Engine Override" can be supplied in case the vehicle is to operate in a critical situation.

NOTE:

The "Stop Engine Override" and "Diagnostic Request" switch is the same.

In this situation the operator may elect to "override" the automatic stop engine sequence by pressing the "Stop Engine Override" switch, located on the instrument panel, until a safe stop can be made. The operator only needs to press the override switch every 15 to 20 seconds to prevent engine shutdown from occurring.

NOTICE:

For some applications, holding the "Stop Engine Override" switch in will not prevent the engine shutdown sequence. You must continue to reset the automatic shutdown system by pressing the "Stop Engine Override" switch at intervals of approximately 15 to 20 seconds.

An important thing to remember is that it takes 30 seconds from the time the automatic shutdown sequence begins until engine shutdown. Therefore, the operator must press the override switch just prior to engine shutdown and continue to do so until the vehicle can be brought to a safe stop.

The immediate speed reduction option will bring engine rpm back to a predetermined speed, but will not shut down the engine.

The engine should not be restarted after it has been shut down by the engine protection system unless the problem has been located and corrected.

The conditions that will cause the "Stop Engine" light (SEL) to come on are:

- High coolant temperature
- Loss of coolant
- High oil temperature
- Low oil pressure
- Auxiliary shutdown

It is important to point out that whenever the "Check Engine" light (CEL) or the "Stop Engine" light (SEL) comes on, the DDEC computer will determine where the problem is, and will then store this information in its memory.

If the malfunction is intermittent, the "Lights" will come on and go off as the computer senses the changing engine condition.

A special diagnostic tool (Diagnostic Data Reader or "DDR") is available that can be plugged into the engine computer memory to extract information related to the cause of the problem. See Figure 9.

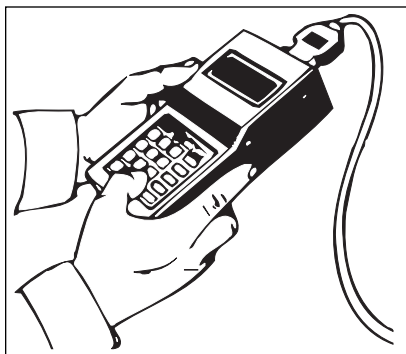


Figure 9. Diagnostic Data Reader J38500

Once the malfunction has been corrected, the DDEC system will return the engine to normal operation.

The DDR can distinguish between codes now active and those stored in the ECM memory (inactive).

The malfunction code recorded in the computer memory will remain until it is erased by a technician.

The malfunction code can also be obtained by the operator. A "Diagnostic Request" switch is provided which, when pressed, will cause the "Check Engine" light (CEL) to flash a code number. It will, for example, flash twice ... pause ... flash five times ... pause. In other words a code 25. See Figure 10.

Code 25 indicates all systems are working satisfactorily.

The **active codes** will be flashed on the "Stop Engine" light (SEL) in the order of most recent to least recent occurrence based on engine hours. If there are no active codes, a code "25" will be flashed.

The **inactive codes** will be flashed on the "Check Engine" light (CEL) in the order of most recent to least recent

occurrence based on engine hours. If there are no inactive codes, a code "25" will be flashed.

Note that only one light will be flashing codes at any time. When code flashing is initiated, the active codes (or code "25") will be flashed on the SEL. Then the inactive codes (or code "25") will be flashed on the CEL. When all the inactive codes (or code "25") have been flashed, the process of flashing all the active codes followed by all the inactive codes will repeat until the conditions for code flashing are no longer satisfied.

The codes will continue to flash and repeat as long as the diagnostic request switch is held in the "On" position with the ignition on. Other diagnostic codes are listed in Table 1.

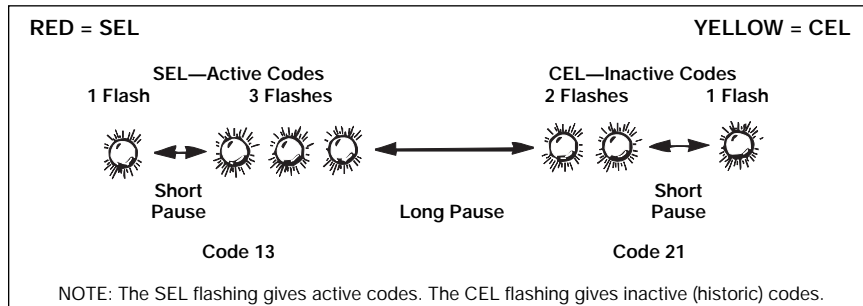


Figure 10. SEL/CEL Examples

<u>Flash Code</u>	<u>DDEC III/IV Description</u>	<u>Flash Code</u>	<u>DDEC III/IV Description</u>
11	VSG sensor input voltage low	52	ECM A/D conversion fail
12	VSG sensor input voltage high	53	ECM non volatile memory fault
13	Coolant level sensor input voltage low	54	Vehicle speed sensor fault
14	Oil or coolant temp. sensor input voltage high	55	J1939 data link fault
15	Oil or coolant temp. sensor input voltage low	55	Missing other ECU information
16	Coolant level sensor input voltage high	56	J1587 data link fault
17	Throttle valve position sensor input voltage high	57	J1922 data link fault
18	Throttle valve position sensor input voltage low	61	Injector response time long
21	TPS input voltage high	62	Aux. output short to battery (+) or open circuit, or mech. fault
22	TPS input voltage low	63	PWM drive short to battery (+) or open circuit
23	Fuel temp. sensor input voltage high	64	Turbo speed sensor input fault
24	Fuel temp. sensor input voltage low	65	Throttle valve position input fault
25	No active codes	66	Engine knock sensor input fault
26	Aux. engine shutdown #1 or #2, input active	67	Air inlet pressure sensor input voltage fault
27	Air inlet or intake air, temp. sensor input voltage high	68	TPS idle validation switch open circuit or short to ground
28	Air inlet or intake air, temp. sensor input voltage low	71	Injector response time short
31	Aux. high side output open circuit or short to ground	72	Vehicle overspeed
32	CEL or SEL short to battery (+) or open circuit	73	Gas valve position input fault or ESS fault
33	Turbo boost sensor input voltage high	74	Optimized Idle® safety loop short to ground
34	Turbo boost input voltage low	75	ECM battery voltage high
35	Oil pressure sensor input voltage high	76	Engine overspeed with engine brake
36	Oil pressure sensor input voltage low	77	Fuel Temperature High
37	Fuel pressure sensor input voltage high	81	EGR Temperature circuit failed high
38	Fuel pressure sensor input voltage low	81	EGR Delta pressure circuit failed high
39	EGR Valve not responding	82	EGR Temperature circuit failed low
39	VNT Vanes not responding	82	EGR Delta pressure circuit failed low
41	Too many SRS (missing TRS)	83	EGR gas temperature high
42	Too few SRS (missing SRS)	83	EGR Delta pressure high
43	Coolant level low	85	Engine overspeed
44	Oil or coolant or intake air, temp. high	86	External pump pressure sensor input voltage high
45	Oil pressure low	87	External pump pressure sensor input voltage low
46	ECM battery voltage low	88	Coolant pressure low
46	RTC backup battery voltage low	89	Fuel filter restriction high
47	Fuel, air inlet, or turbo boost, pressure high		
48	Fuel or air inlet pressure low		
48	EGR temperature low		
48	EGR Delta pressure low		

TO READ CODES: Use the diagnostic data reader or depress and hold the diagnostic request switch with the ignition on, engine at idle or not running. Press and hold the switch. Active codes will be flashed on the "Stop Engine" light (SEL) followed by the inactive codes being flashed on the "Check Engine" light (CEL). The cycle will repeat until the operator releases the diagnostic request switch.

Table 1. DDEC III/IV System Diagnostic Codes

Welding Precaution

NOTICE:

To prevent damage to the DDEC electronic control module and other DDEC components, disconnect battery power and ground cables and the 5-pin power connector at the ECM (electronic control module) before welding. **Failure to isolate the DDEC system from high current flow can result in severe ECM damage.**



CAUTION:

To avoid injury from engine shutdown in an unsafe situation, ensure the operator knows how to override the stop engine condition on a DDEC-equipped unit.



CAUTION:

To avoid injury from loss of vehicle/vessel control, the operator of a DDEC equipped engine must not attempt to use or read the Diagnostic Data Reader when the vehicle/vessel is moving.

DDEC III/IV ENGINE DRIVING TIPS

Accelerating the Vehicle

Engine response versus pedal movement may feel different from the mechanical governed engine you were driving. The electronic foot pedal assembly was designed to communicate "percentage" foot pedal travel to the engine's electronic control module. The engine will respond accordingly to the driver's demand.

Another throttle or governor characteristic you may need some time to get used to is the DDEC limiting speed governor. This allows the driver to command total engine response between idle and rated speed, such as accelerating at half throttle - an advantage when driving under slippery conditions.

If you do require wide open throttle engine response, either accelerating or just plain pulling hard, the throttle will have to be held to the floor. To obtain 100% fueling at any speed, the foot pedal will have to be maintained at the fully depressed position.

Cruise Control

For added driver convenience and comfort, DDEC III also features a cruise control option which works just like the system in your car. It can be operated in any gear above 1100 RPM or road speed faster than 20 MPH, up to the rated engine speed. And it can be programmed to hold your road speed at or below the maximum vehicle speed. The switch to energize cruise control is usually mounted on the instrument panel. Turn the switch to the *on* position to energize the system. When you reached your road speed, press the *set*

switch to activate cruise control. The *cruise* light will come on. To increase road speed in one MPH increments, press the *resume/accel* switch. To reduce road speed, press and hold the *set/coast* switch until the lower speed is reached. Cruise control is deactivated by slightly depressing the service brake, clutch pedal, or trailer brake. Also, the *on/off* switch deactivates cruise control. Cruise control will maintain speed even on upgrades, unless power requirements demand a downshift. And, of course, cruise control doesn't limit your speed on down grades. Most likely, the cruise control will feel stronger than driving with the foot pedal because of the instantaneous and wide open throttle response. That is why cruise control use is **not** suggested during slippery driving conditions.

Use cruise control after down shifting on a hill to pull the hill. Hitting the *resume* switch (*not the set switch*) will keep the truck accelerating in the lower gears up to rated engine speed.

Cruise control will disengage below 1100 RPM or 20 MPH road speed. When using cruise control, if you want to pull the engine below 1100 RPM, remember to hold the throttle pedal to the floor to keep the engine pulling at wide-open throttle. Realistically, the engine will pull to about 1050 RPM. Remember: The electronic data programmed into the ECM will not allow you to hurt or overfuel the engine at low or lug engine speeds. There is enough oil pressure to withstand hard pulls at low engine speeds.

Jake Brakes

If your engine is equipped with both cruise control and Jake Brake® retarders, the Jakes can operate automatically while you are in cruise control. If the cruise control/engine brake function is turned on in the ECM programming, the Jakes will come on "low" when your set road speed increases a few MPH or KPH above your cruise set speed. If your speed continues to increase, the ECM will increase the Jakes' braking power progressively. When the vehicle returns to the set cruise speed, the Jakes will "turn off" until the next time you need them. For safety reasons, don't use cruise control when it's not possible to keep the vehicle at constant speed due to winding roads ... heavy traffic ... slippery roads ... or when descending grades that call for Jake Brake assistance.

Shifting

Depending on your transmission model, the gear split may vary from 500 to 300 RPM. The electronic governor provides almost no overrun capability; and if the transmission is downshifted too early, you will experience a temporary loss of pulling power until the engine speed falls below rated speed. In general, when using a 7 or 9-speed transmission, you should always downshift between 1250 and 1300 RPM. This is true even on steep grades with heavy loads. When using an 18, 15 or 13 speed transmission, you will need to downshift at an RPM that allows "less than rated" RPM before throttle application in the next gear down. You may want to limit engine speed to 1900 RPM in all gears. The Series 60 provides constant horsepower from 1800 RPM through 2100 RPM, but fuel economy is not as efficient above 1800 RPM.

If you decide to drive at lower RPM's for improved fuel economy, don't let different engine noises throw you off guard. The Series 60 sounds quiet at 1400 RPM, almost as if it had quit pulling. Don't believe it! If you had a boost gage to look at while driving, you would notice the turbocharger maintaining steady intake manifold pressure, even as RPM's fall. Depending on the air intake arrangement, you may also experience a "chuffing" sound as the engine starts to pull hard at the lower RPM's. This is caused by the velocity changes of the air flow within the air intake plumbing. Electronic engines can actually deliver more fuel at lower engine speeds than at rated speed.

Idling

The common belief that idling a diesel engine causes no engine damage is wrong. Idling produces sulfuric acid which breaks down the oil and eats into bearings, rings, valve stems and engine surfaces. If you must idle the engine for cab heat or cooling, the *high idle* function of the cruise control switches should be utilized. An idle speed of 1100 RPM should be enough to provide cab heat in above 32°F (0°C) ambients. A winter front may be used to improve cab heating while idling, but it should never cover more than 3/4 of the grill while driving. Winter fronts should only be used when the ambient temperature remains below 10° F (-12.2° C).

ENGINE SYSTEMS

Fuel System

The fuel system consists of the DDEC electronic fuel system controls, fuel injectors, fuel manifolds (integral with the cylinder head), fuel pump, a cooling plate for the electronic control module (ECM) on non-automotive engines, primary and secondary fuel filters, and the necessary connecting fuel lines.

The primary filter (marked "P") or combination filter and fuel/water separator removes large impurities from the fuel. The secondary filter (marked "S") removes the smaller particles.

Lubrication System

The lubricating oil system consists of an oil pump, oil cooler, two full flow oil filters, bypass valves at the oil pump and oil filter adapter, and pressure regulator valve in the cylinder block vertical oil gallery.

Air System

In the air system used on Series 60 engines, outside air drawn into the engine passes through the air filter and is pulled into the turbocharger, where it is compressed. It then moves to the air-to-air charge cooler (heat exchanger) where it is cooled. From here it flows to the intake manifold and into the cylinders, where it mixes with atomized fuel from the injectors.

Dry type air cleaners are used on Series 60 engines. For optimum protection of the engine from dust and other airborne contaminants, **service these air cleaners when the maximum allowable air restriction has been reached, or annually, whichever occurs first.**

Cooling System

A radiator/thermo-modulated fan cooling system is used on Series 60 engines. This system has a centrifugal type fresh water pump to circulate coolant within the engine. Two full blocking type thermostats located in a housing attached to the right side of the cylinder head control the flow of coolant.

Electrical System

The electrical system consists of a starting motor, starting switch, battery-charging alternator, storage batteries, and the necessary wiring.

Exhaust System

Hot exhaust gas flowing from the exhaust manifold into the exhaust riser is used to drive the turbocharger.



CAUTION:

Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects and other reproductive harm.

- **Always start and operate the engine in a well-ventilated area.**
- **If operating the engine in an enclosed area, vent the exhaust to the outside.**
- **Do not modify or tamper with the exhaust system or emission control system.**

Maintenance Interval Schedules

Recommended maintenance intervals for Series 60 on-highway truck and parlor coach engines are listed in Table 2. Recommended maintenance intervals for Series 60 transit coach engines are listed in Table 3. Recommended maintenance intervals for Series 60 construction/industrial and stationary engines are listed in Table 4. Recommended maintenance intervals for Series 60 fire fighting, crash/rescue, and emergency vehicle engines are listed in Table 5. Recommended maintenance intervals for generator drive engines are listed in Table 6.

NOTICE:

Coolant *must* be inhibited with the recommended SCA's (supplemental coolant additives) listed in the "How to Select Coolant" section of this engine operator's guide. In addition, the engine can be equipped with a coolant filter/inhibitor system as an installed option or as an after-sale item. Failure to check and maintain SCA levels at required concentrations will result in severe damage (corrosion) to the engine cooling system and related components.

ITEM		DAILY									
1—Lubricating Oil*		I									
2—Fuel Tank*		I									
3—Fuel Lines and Flexible Hoses*		I									
4—Cooling System*		I									
5—Turbocharger*		I									
ITEM 7500 MILE (12,000 KM) INTERVAL											
6—Battery*		I									
8—Drive Belts*		I									
9—Air Compressor*		I									
ITEM 15,000 MILE (24,000 KM) INTERVAL											
1—Lubricating Oil*		R									
7—Tachometer Drive*		I									
10—Air Cleaner*		I									
11—Lubricating Oil Filter*		R									
12—Fuel Filters*		R									
13—Coolant/Inhibitor Level*		I									
ITEM	MONTHS	6	12	18	24	30	36	42	48	54	60
	MILES/KM (1000)	15/24	30/48	45/72	60/96	75/120	90/144	105/168	120/192	135/216	150/240
1—Lubricating Oil*		R	R	R	R	R	R	R	R	R	R
2—Fuel Tank*			I		I		I		I		I
4—Cooling System*					I				I		
7—Tachometer Drive		I	I	I	I	I	I	I	I	I	I
8—Drive Belts*		I	I	I	I	I	I	I	R	I	I
9—Air Compressor*		I	I	I	I	I	I	I	I	I	I
11—Lubricating Oil Filter*		R	R	R	R	R	R	R	R	R	R
12—Fuel Filters*		R	R	R	R	R	R	R	R	R	R
13—Coolant Pump/Inhibitor Level*		I	I	I	I	I	I	I	I	I	I
14—Cranking Motor*		Follow Manufacturer's Recommendations									
15—Air System*		I	I	I	I	I	I	I	I	I	I
16—Exhaust System*		I	I	I	I	I	I	I	I	I	I
17—Engine (Steam Clean)*											
18—Radiator & A/A Charge Cooler*			I		I		I		I		I
19—Oil Pressure*					I				I		
20—Battery Charging Alternator*			I		I		I		I		I
21—Engine & Transmission Mounts*					I				I		
22—Crankcase Pressure*					I				I		
23—Fan Hub*									I		
24—Thermostats & Seals*									I		
25—Crankcase Breather*									I		
26—Engine Tune-Up*					I						
27—Vibration Damper*											

MAINTENANCE

SERVICE RECOMMENDATIONS

ON-HIGHWAY TRUCK OR PARLOR COACH

CODES: **I**—Inspect, Service, Correct or
Replace as Necessary

R—Replace
*See Item in Text

Table 2. Engine Maintenance—On-Highway Truck and Parlor Coach

ITEM		DAILY									
1—Lubricating Oil*		I									
2—Fuel Tank*		I									
3—Fuel Lines and Flexible Hoses*		I									
4—Cooling System*		I									
5—Turbocharger*		I									
ITEM 6000 MILE (9,600 KM) INTERVAL											
1—Lubricating Oil*		R									
11—Lubricating Oil Filter*		R									
ITEM 7500 MILE (12,000 KM) INTERVAL											
6—Battery*		I									
8—Drive Belts*		I									
9—Air Compressor*		I									
ITEM 15,000 MILE (24,000 KM) INTERVAL											
7—Tachometer Drive*		I									
10—Air Cleaner*		I									
12—Fuel Filters*		R									
13—Coolant/Inhibitor Level*		I									
ITEM	MONTHS	6	12	18	24	30	36	42	48	54	60
	MILES/KM (1000)	15/24	30/48	45/72	60/96	75/120	90/144	105/168	120/192	135/216	150/240
1—Lubricating Oil*		R	R	R	R	R	R	R	R	R	R
2—Fuel Tank*			I		I		I		I		I
4—Cooling System*					I				I		
7—Tachometer Drive		I	I	I	I	I	I	I	I	I	I
8—Drive Belts*		I	I	I	I	I	I	I	I	R	I
9—Air Compressor*	I	I	I	I	I	I	I	I	I	I	
11—Lubricating Oil Filter*		R	R	R	R	R	R	R	R	R	R
12—Fuel Filters*		R	R	R	R	R	R	R	R	R	R
13—Coolant Pump/Inhibitor Level*		I	I	I	I	I	I	I	I	I	I
14—Cranking Motor*	Follow Manufacturer's Recommendations										
15—Air System*		I	I	I	I	I	I	I	I	I	I
16—Exhaust System*		I	I	I	I	I	I	I	I	I	I
17—Engine (Steam Clean)*											
18—Radiator & A/A Charge Cooler*			I		I		I		I		I
19—Oil Pressure*					I				I		
20—Battery Charging Alternator*			I		I		I		I		I
21—Engine & Transmission Mounts*					I				I		
22—Crankcase Pressure*					I				I		
23—Fan Hub*									I		
24—Thermostats & Seals*									I		
25—Crankcase Breather*									I		
26—Engine Tune-Up*					I						
27—Vibration Damper*											

CODES: **I**—Inspect, Service, Correct or Replace as Necessary

R—Replace

*See Item in Text

Table 3. Engine Maintenance—Transit Coach

ITEM		DAILY										
1—Lubricating Oil*		I										
2—Fuel Tank*		I										
3—Fuel Lines and Flexible Hoses*		I										
4—Cooling System*		I										
5—Turbocharger*		I										
ITEM		100 HOURS 3,000 MILES										
6—Battery*		I										
8—Drive Belts*		I										
ITEM		150 HOURS 4,500 MILES										
1—Lubricating Oil*		R										
7—Tachometer Drive*		I										
9—Air Compressor*		I										
10—Air Cleaner*		I										
11—Lubricating Oil Filter*		R										
12—Fuel Filters*		R										
ITEM		200 HOURS 6,000 MILES										
13—Coolant/Inhibitor Level*		I										

MAINTENANCE

SERVICE RECOMMENDATIONS

STATIONARY OR CONSTRUCTION/ INDUSTRIAL ENGINES

ITEM	HOURS	150	300	450	600	750	900	1050	1200	1350	1500
	MILES/KM (1000)	4.5/7.2	9.0/14.4	13.5/21.6	18/28.8	22.5/36	27/43.2	31.5/50.4	36/57.6	40.5/64.8	45/72
1—Lubricating Oil*		R	R	R	R	R	R	R	R	R	R
2—Fuel Tank*			I		I		I		I		I
4—Cooling System*					I				I		
7—Tachometer Drive*		I	I	I	I	I	I	I	I	I	I
9—Air Compressor*		I	I	I	I	I	I	I	I	I	I
11—Lubricating Oil Filter*		R	R	R	R	R	R	R	R	R	R
12—Fuel Filters*		R	R	R	R	R	R	R	R	R	R
13—Coolant Pump/Inhibitor Level*		I	I	I	I	I	I	I	I	I	I
14—Cranking Motor*		Follow Manufacturer's Recommendations									
15—Air System*		I	I	I	I	I	I	I	I	I	I
16—Exhaust System*		I	I	I	I	I	I	I	I	I	I
17—Engine (Steam Clean)*											
18—Radiator*			I		I		I		I		I
19—Oil Pressure*					I				I		
20—Battery Charging Alternator*			I		I		I		I		I
21—Engine & Transmission Mounts*					I				I		
22—Crankcase Pressure*					I				I		
23—Fan Hub*								I			
24—Thermostats & Seals*											
25—Crankcase Breather*								I			
26—Engine Tune-Up*											I
27—Vibration Damper*											

MAINTENANCE

SERVICE RECOMMENDATIONS

STATIONARY OR CONSTRUCTION/ INDUSTRIAL ENGINES

CODES: **I**—Inspect, Service, Correct or
Replace as Necessary

R—Replace
*See Item in Text

Table 4. Engine Maintenance—Stationary and Construction/Industrial Engines

ITEM		DAILY				
1—Lubricating Oil*						I
2—Fuel Tank*						I
3—Fuel Lines and Flexible Hoses*						I
4—Cooling System*						I
5—Turbocharger*						I
ITEM		100 HOURS 3,000 MILES				
6—Battery*						I
8—Drive Belts*						I
ITEM		300 HOURS 6,000 MILES				
1—Lubricating Oil*						R
7—Tachometer Drive*						I
9—Air Compressor*						I
10—Air Cleaner*						I
11—Lubricating Oil Filter*						R
12—Fuel Filters*						R
13—Coolant/Inhibitor Level*						I
ITEM		HOURS	300	600	900	1200
		MILES/KM (1000)	6/1.6	12/9.6	18/28.8	24/38.4
1—Lubricating Oil*			R	R	R	R
2—Fuel Tank*			I	I	I	I
4—Cooling System*				I		I
7—Tachometer Drive*			I	I	I	I
9—Air Compressor*			I	I	I	I
11—Lubricating Oil Filter*			R	R	R	R
12—Fuel Filters*			R	R	R	R
13—Coolant Pump/Inhibitor Level*			I	I	I	I
14—Cranking Motor*			Follow Manufacturer's Recommendations			
15—Air System*			I	I	I	I
16—Exhaust System*			I	I	I	I
17—Engine (Steam Clean)*						
18—Radiator*			I	I	I	I
19—Oil Pressure*				I		I
20—Battery Charging Alternator*			I	I	I	I
21—Engine & Transmission Mounts*				I	I	
22—Crankcase Pressure*				I		I
23—Fan Hub*					I	
24—Thermostats & Seals*						
25—Crankcase Breather*					I	
26—Engine Tune-Up*						I
27—Vibration Damper*						

MAINTENANCE

SERVICE RECOMMENDATIONS

FIRE FIGHTING, CRASH/RESCUE, AND EMERGENCY VEHICLES

CODES: **I**—Inspect, Service, Correct or
Replace as Necessary

R—Replace
*See Item in Text

Table 5. Engine Maintenance—Fire Fighting, Crash/Rescue, and Emergency Vehicles

ITEM	Prime, Daily	Standby, Monthly	HOURS							
			1	3	6	1	1	2	3	4
			5	0	0	0	5	0	0	0
1. Lubricating Oil*	I	I#	0	0	0	0	0	0	0	0
			STANDBY Replace every 150 hours or one year, whichever comes first PRIME POWER Replace every 250 hours or three months, whichever comes first							
2. Fuel & Fuel Tank*	I	I			I					
3. Fuel Lines, Flexible Hoses*	I				I			R		
4. Cooling System*	I	I#								R
5. Turbocharger*	I									
6. Battery*		I	I							
7. Tachometer Drive*			I							
8. Drive Belts*	I	I	I							
10, 15. Air System, Cleaners*	I	I	I							
11. Lubricating Oil Filter*										
12. Fuel Filters, Water Separator*	I	I#	STANDBY Replace every 150 hours or one year, whichever comes first PRIME POWER Replace every 150 hours or one month, whichever comes first							
13. Water Pump/Inhibitor Level*									I	
14. Cranking Motor*	Follow Manufacturer's Recommendations									
16. Exhaust Connections*	I				I					
17. Engine, Steam Clean*								I		
18. Radiator*				I						
19. Oil Pressure*	I	I#			I					
20. Battery Charging Alternator*					I					
21. Engine/Generator Mounts*					I					
22. Crankcase Pressure*					I					
23. Fan Hub*						I				
24. Thermostats and Seals*										R
25. Crankcase Breather*						I				R
26. Engine Tune-up/Injector*							I			
27. Vibration Damper*										
Load Test		P								

CODES: **I**-Inspect **R**-Replace **P**-Perform

#Perform these items at time of Load Test. Load Test should be at least 35% of the unit's full rated output. Refer to generator set manufacturer's instructions.

*See Item in Text

Table 6. Engine Maintenance—Generator Drive Engines

LUBRICATION AND PREVENTIVE MAINTENANCE INTERVALS

The following is intended as a guide for establishing preventive maintenance intervals. The recommendations given should be followed as closely as possible to obtain long life and optimum performance from Series 60 engines. Intervals indicated on the chart are time (hours) of actual operation.

The intervals shown apply only to the maintenance functions described. These functions should be coordinated with other regularly scheduled maintenance.

The "daily" instructions apply to routine or daily starting of an engine. They do not apply to a new engine or one that has not been operated for a considerable period of time. For new or stored engines, refer to the *Series 60 Engine Service Manual* (6SE483). Follow instructions given in Section 13.1 under **Preparations for Starting the Engine the First Time**.

Preventive maintenance other than the "daily" checks should be performed by authorized Detroit Diesel service outlets. These outlets have the trained personnel and special tools to properly perform all services.

Item 1 - Lubricating Oil

Check the oil level daily with the engine stopped. If the engine has just been stopped and is warm, wait approximately 20 minutes to allow the oil to drain back to the oil pan before checking. Add the proper grade of oil to maintain the correct level on the dipstick. See Figure 11.

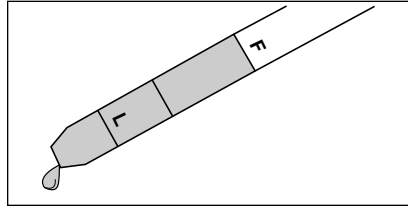


Figure 11. Check Oil Level Daily

All diesel engines are designed to use some oil, so the periodic addition of oil is normal. See Figure 12, "Engine Oil Consumption Guidelines" to determine the degree of oil usage.

NOTICE:

Do not overfill. Oil may be blown out through the crankcase breather if the crankcase is overfilled.

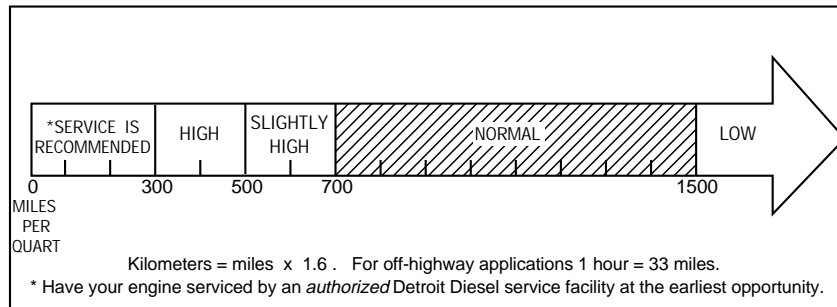


Figure 12. Engine Oil Consumption Guidelines

NOTICE:

If the oil level is constantly above normal and excess lube oil has not been added to the crankcase, consult with an authorized Detroit Diesel service outlet for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

Before adding lubricating oil, refer to **How to Select Lubricating Oil** in the **How To** section of this guide. Change lubricating oil and filters at the intervals listed in Table 7 when using fuel with a sulfur content of less than 0.5 mass percent. When using fuel with a higher sulfur content, refer to **When to Change Oil** in the **How To** section.

Service Application	Lube Oil/Filter* Change Interval
Highway Truck & Motor Coach	15,000 miles or 24,000 kilometers
City Transit Coach	6,000 miles (9,600 km), 300 hours, or 3 months, whichever comes first
Fire Fighting, Crash/Rescue, and Emergency Vehicle	6,000 miles (9,600 km), 300 hours, or 1 year, whichever comes first
Industrial and Agricultural	250 hours or 1 yr., whichever comes first
Stationary Generator, Prime Power or Continuous	250 hours or 3 months, whichever comes first
Stationary Generator, Standby	150 hours or 1 year, whichever comes first

*Change both full-flow filters when lube oil is changed.

Table 7. Recommended Engine Oil Drain and Filter Change Intervals
(Diesel Fuel Sulfur Content Less Than 0.5 Mass %)

Item 2 — Fuel and Fuel Tank

Keep the fuel tank filled to reduce condensation. See Figure 13. Before adding fuel, refer to **How to Select Fuel Oil** in the **How To** section of this guide.

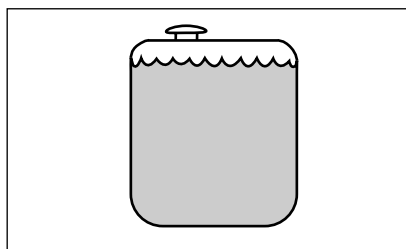


Figure 13. Keep Tank Filled to Reduce Condensation

Refill the tank at the end of each day's operation to prevent condensation from contaminating the fuel. Condensation formed in a partially filled tank promotes the growth of microorganisms that can clog fuel filters and restrict fuel flow. To prevent microbe growth add a biocide to the fuel tank or primary fuel supply. Follow manufacturer's usage, handling, and safety recommendations.

Water accumulation can be controlled by using additives containing methyl carbitol or butyl cellusolve. Follow manufacturer's usage, handling, and safety precautions.

Open the drain at the bottom of the fuel tank every 30,000 miles or 48,000 km (300 hours for industrial applications) to drain off any water and/or sediment.

Every 12 months or 120,000 miles (192,000 km) (600 hours for industrial applications) tighten all fuel tank mount-

ings and brackets. At the same time, check the seal in the fuel tank cap, the breather hole in the cap and the condition of the flexible fuel lines. Repair or replace the parts, as necessary.

NOTICE:

Galvanized steel fuel tanks, fittings, or supply lines should never be used because the fuel oil reacts chemically with the zinc coating to form powdery flakes which can quickly clog the fuel filters and damage the fuel pump and injectors.

Item 3 — Fuel Lines, Flexible Hoses

Pre-Start Inspection—Make a visual check for fuel leaks at all engine-mounted fuel lines and connections, and at the fuel tank suction and return lines. Since fuel tanks are susceptible to road hazards, leaks in this area may best be detected by checking for accumulation of fuel under the tanks. Check hoses daily as part of the pre-start inspection. Examine hoses for leaks, and check all fittings, clamps, and ties carefully. Make sure that hoses are not resting on or touching shafts, couplings, heated surfaces including exhaust manifolds, any sharp edges, or other obviously hazardous areas. Since all machinery vibrates and moves to a certain extent, clamps and ties can fatigue with age. To ensure continued proper support, inspect fasteners frequently and tighten or replace them as necessary.

If fittings have loosened or cracked or if hoses have ruptured or worn through, take corrective action immediately. Leaks are not only potentially detrimental to machine operation, but they can also result in added expense caused by the need to replace lost fluids.



CAUTION:

To avoid injury from fire, contain and eliminate leaks of flammable fluids as they occur. Failure to eliminate leaks could result in fire.

Service life—A hose has a finite service life. With this in mind, all hoses should be thoroughly inspected at least every 500 operating hours (1,000 hours for fire-resistant fuel and lubricating oil hoses) and/or annually. Look for cover damage and/or indications of twisted, worn, crimped, brittle, cracked, or leaking lines. Hoses with their outer cover worn through or damaged metal reinforcement should be considered unfit for further service.

All hoses in and out of machinery should be replaced during major overhaul and/or after a maximum of five years of service. Fire resistant fuel and lube oil hose assemblies do not require automatic replacement after five years service or at major overhaul, but should be inspected carefully before being put back into service.

Item 4 - Cooling System



CAUTION:

To avoid injury from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Remove the cap slowly to relieve pressure. Wear adequate protective clothing (face shield or safety goggles, rubber gloves, apron, and boots).

Check the coolant level daily and maintain it near the bottom of the filler neck on the radiator. On some installations this is done by checking an overflow bottle or sight glass. Add coolant as necessary, but do not overfill. Before adding coolant, refer to **How to Select Coolant** in the **How To** section of this guide.

Make a daily visual check for cooling system leaks. Look for an accumulation of coolant when the engine is running and when it is stopped. Coolant leaks may be more apparent on an engine when it is cold.

The inhibitors in antifreeze solutions should be replenished with a non-chromate corrosion inhibitor supplement when indicated by testing the coolant.

Refer to **How to Select Coolant** for required test intervals and inhibitor levels.

Coolant Drain Interval—Detroit Diesel recommends replacing coolant at the intervals listed in Table 9.

A coolant system properly maintained and protected with supplemental coolant inhibitors can be operated up to the intervals shown below. At these intervals the coolant must be drained, disposed of in an environmentally responsible manner, according to state and/or federal EPA Refer to "Inhibitor Test Procedures" under **How to Select Coolant** and use the required supplemental additives or filter/conditioner elements listed in Tables 21-28 of the Specifications Section.

Coolant Type	Coolant Replacement Interval
A 50/50 mix of <i>POWER Cool</i> fully formulated inhibited ethylene glycol antifreeze and water or a 50/50 mix of fully formulated inhibited propylene glycol antifreeze and water.	With proper maintenance ¹ coolant can be operated 2 years, 300,000 miles, (480,000 km), 4,000 hours, or 2 years, whichever comes first. At this time the cooling system must be completely drained and cleaned before refill.
A 50/50 mix of phosphate-free TMC RP-329 "Type A" (Ethylene Glycol) or TMC RP-330 "Type A" (Propylene Glycol) antifreeze and water.	With proper maintenance ¹ coolant can be operated for the life of the engine until overhaul. ² For life to overhaul, pre-charged coolant in combination with a need-release filter <i>must</i> be used. At this time the cooling system must be completely drained and cleaned before refill.
A 50/50 mix of NOAT (Nitrited Organic Acid Technology) coolant and water.	With proper maintenance coolant can be operated 4 years, 600,000 miles, (960,000 km), or 10,000 operating hours, whichever comes first. ³ At this time the cooling system must be completely drained and cleaned before refill.

¹Proper maintenance involves periodic evaluation using Power Trac® 3-Way Coolant Test Strips and the addition of required SCA, as indicated by the test strip.


²To verify coolant acceptability, submit a sample to DDC for coolant analysis every 3 years, 300,000 miles, (480,000 km), or 6,000 operating hours, whichever comes first. Submit sample in Power Trac Coolant Test Bottle, part number 23508774.

³NOAT coolants require the addition of an extender every 300,000 miles, (480,000 km), 5,000 hours, or 2 years, whichever comes first. Use 1 pint to 20 gallons of NOAT coolant.

Table 8. Coolant Drain Intervals

Cooling System Hoses—All cooling system hoses should be inspected at least every 500 hours for signs of deterioration and replaced, if necessary.

Item 5 — Turbocharger, Air-to-Air Charge Cooler


	<p>CAUTION:</p> <p>To avoid injury from hot surfaces, allow engine to cool before removing any component. Wear protective gloves.</p>
-------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------

Visually inspect the mountings, intake and exhaust ducting and connections for leaks daily. Check the oil inlet and outlet lines for leaks or restrictions to oil flow. Check for unusual noise or vibration and, if excessive, stop the engine and do not operate until the cause is determined.

Periodically inspect the air-to-air charge cooler (if used) for dirt, mud, etc. buildup and wash off. Check the cooler, ductwork, and flexible connections for leaks and have repaired or replaced, as required.

Check heat-insulating exhaust system blankets (if used) for damage daily. Torn, matted, crushed, oil-soaked, or otherwise damaged insulation blankets must be replaced immediately.

Item 6 — Battery

	<p>CAUTION:</p> <p>To avoid injury from accidental engine startup while servicing the engine, disconnect/disable the starting system.</p>
-----------------------------------------------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------

Check the hydrometer "eye" of maintenance-free batteries for charge. See Figure 14. If lead-acid or low maintenance batteries are used, check the specific gravity of each cell every 150 hours. Check more frequently in warm weather due to the more rapid loss of water through evaporation.

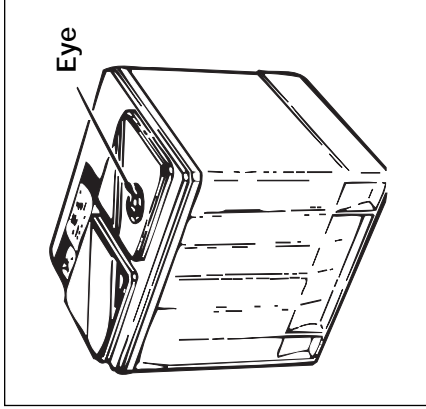


Figure 14. Check "Eye" of Maintenance-Free Batteries

Maintain the electrolyte level according to the battery manufacturer's recommendations, but do not overfill. Overfilling can cause poor performance or early failure.

Keep the terminal side of the battery clean. When necessary, wash with a solution of baking soda and water. Rinse with fresh water. Do not allow the soda solution to enter the cells.

Inspect the cables, clamps, and hold-down brackets regularly. Clean and reapply a light coating of petroleum jelly when needed. Have corroded or damaged parts replaced.

If the engine is to be out of service for more than 30 days, remove the batteries and store in a cool, dry place. Keep batteries fully charged, if possible. Replace any battery that fails to hold a charge.

Periodically check battery connections for corrosion and tightness. If necessary, remove connections and wire brush any corrosion from terminals and cable ends. Replace damaged wiring.

Item 7 — Tachometer Drive

A typical tachometer drive take-off location is the camshaft drive gear access cover on the front of the gear case cover. Lubricate the tachometer drive (if so equipped) every 150 hours or 15,000 miles (24,000 km) with an all purpose grease. At temperatures above -1°C; (+30°F), use a No. 2 grade grease. Use a No. 1 grade grease below this temperature.

Item 8 — Drive Belts

Belts should be neither too tight nor too loose. Belts that are too tight impose excess loads on the crankshaft, fan and/or alternator bearings, shortening both belt and bearing life. Excessively overtightened belts can result in crankshaft breakage. A loose belt will

slip and may cause damage to accessory components.



CAUTION:

To avoid injury from rotating belts and fans, do not remove and discard safety guards.

Use a Belt Tension Gage, such as Kent-Moore tool J 23586-B (V belt), J 23600-B (Poly-V belt), J 41251-B (PowerBand® and 12-Rib Poly-V belt) or equivalent, when tensioning drive belts. Tension belts to the values listed in Table 9.

FAN DRIVE		
SINGLE BELT	2 OR 3 BELTS	
80-100 lbs	60-80 lbs	
ALTERNATOR DRIVE		
BELT	NEW	USED
TWO 1/2" V-GROOVE	125 lbs	100 lbs
2-GROOVE POWERBAND®	200 lbs	150 lbs
12-RIB POLY-V 50 DN ALT.	350 lbs	250 lbs

Table 9. Drive Belt Tensioning

V-Belts—New standard V-belts will stretch after the first few hours of operation. Tighten V-belts as shown in the chart. Run the engine for 10 to 15 minutes to seat the belts, then readjust tension. Check and retension belts after 1/2 hour or 15 miles and again after 8 hours or 250 miles (400 km) of operation. Thereafter, check the tension of the drive belts every 100 hours or 6,000 miles (10,000 km) and adjust, if necessary.

If a belt tension gage is not available, adjust the belt tension so that a firm push with the thumb, at a point midway between the two pulleys, will depress the belt 12.70-19.05 mm (.500"-.750").

2-Groove PowerBand®—Tighten a new belt to 200 lbs, then run the engine for 10 minutes at 1200 rpm. Stop the engine and allow a 10-15 minute cool down period. Check tension. If less than 150 lbs, retension to 150 lbs. Following initial tensioning, measure belt tension every month or every 7,500 miles (12,000 km), whichever comes first. Retension belt to 150 lbs at these intervals.

12-Rib Poly-V Belt—Tighten a new belt to 350 lbs then run the engine at high idle for 30 minutes. Stop the engine and allow a 10-15 minute cool down period. Check tension with tool J 41251-B or equivalent. If 250 lbs or more, no retensioning is required. If less than 250 lbs, retension to 250 lbs. Measure belt tension every month or every 7,500 miles (12,000 km), whichever comes first. Retension to 250 lbs as required.

Drive belts (V and Poly-V) should be replaced every 2,000 hours or 100,000 miles (160,000 km).

Replace ALL belts in a set when one is worn. Single belts of similar size should not be used as a substitute for a matched belt set. Premature belt wear can result because of belt length variation. All belts in a matched belt set are within .032" of their specified center distances.

When installing or adjusting an accessory drive belt, be sure the bolt at the accessory adjusting pivot point is properly tightened, as well as the bolt in the adjusting slot. In addition, check the torque on the

alternator and bracket mounting bolts and retighten, as required.

Item 9 — Air Compressor

All air compressor air intake parts should be removed and cleaned at these intervals:

- On-highway vehicle engines — 7,500 miles (12,000 km)
- Industrial engines — 150 hours or 4,500 miles (7,200 km)

To clean either the hair- or polyurethane-type compressor air strainer element, saturate and squeeze it in fuel oil, or any other cleaning agent that would not be detrimental to the element, until it is dirt-free. Then, dip the element in lubricating oil and squeeze it dry before placing it back in the air strainer.

For replacement of the air strainer element, contact the nearest servicing dealer; replace with the polyurethane element, if available.

Every 12 months or 30,000 miles or 48,000 km (300 hours for industrial applications) the air compressor mounting bolts should be tightened.

Item 10 — Air Cleaner

The air cleaner element should be inspected every 15,000 miles (24,000 km) for vehicle engines, 150 hours for non-vehicle engines, or more often if the engine is operated under severe dust conditions. Replace the element if necessary. Check the gaskets for deterioration and replace, if necessary. If the dry type air cleaner is equipped with an aspirator, check for aspirator damage or clogging. Clean and repair as necessary.

Under no engine operating conditions should the air inlet restriction exceed 20 inches of water (5.0 kPa). A clogged air cleaner element will cause excessive intake restriction and a reduced air supply to the engine. This, in turn, can result

in increased fuel consumption, inefficient engine operation and reduced engine life.

Dry-type air cleaner elements should be replaced after one year of service or when the maximum allowable air intake restriction has been reached, whichever comes first. Refer to **When to Service the Dry Type Air Cleaner** (page 61).

Inspect the entire air system for leaks daily. Look especially for torn air inlet piping or boots and loose or damaged clamps. Have worn or damaged parts repaired or replaced, as required. Retighten any loose connections.

Item 11 — Lubricating Oil Filters

Install new spin-on oil filters (see Figure 20) at a **maximum** of 15,000 miles (24,000 km) on vehicle engines or 150 hours on industrial engines or each time the engine oil is changed, whichever comes first. Install the new filters, turning them until they contact the gasket fully with no side movement. Turn full-flow filters an additional 2/3 turn **by hand**.

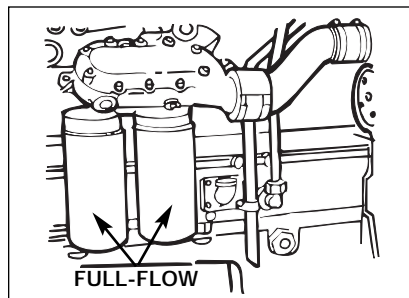


Figure 15. Lubricating Oil Filters

Make a visual inspection of all lubricating oil lines for wear and/or chafing. If any indication of wear is evident, replace the oil lines and correct the cause.

Check for oil leaks after starting the engine.

Item 12 — Fuel Filters

Fuel Pro® 380— Install new Fuel Pro 380 primary filter element when the fuel level in the see-through cover reaches the top of the element or after one year of service, whichever comes first.

Spin-on — Install new spin-on primary or secondary fuel filter elements (see Figure 21) on vehicle engines every 15,000 miles (24,000 km) or every six months, whichever comes first. Install new spin-on filter elements on non-vehicle engines every 150 hours. Replace spin-on elements immediately if plugging is indicated, regardless of mileage or hour intervals.

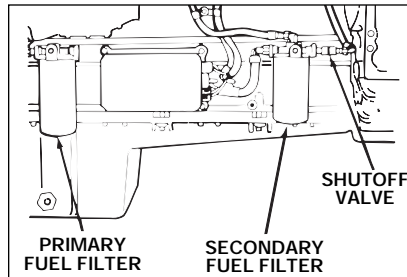


Figure 16. Spin-On Fuel Filter Locations

NOTE:

Filter change intervals may be shortened to conform with established preventive maintenance schedules, but should never be extended.

A method of determining when filters are plugged to the extent that they should be changed is based on the fuel pressure at the cylinder head fuel inlet fitting and the inlet restriction at the fuel pump. In a clean system, the maximum pump inlet restriction should not exceed 6 inches of mercury (20.3 kPa) and must not exceed 12 inches of mercury (41 kPa) with a dirty system.

At normal operating speeds and with the standard .080" restriction fittings, the fuel pressure is 375-483 kPa (55-70 psi). Change the fuel filters whenever the inlet restriction at the fuel pump reaches 12 inches of mercury (41 kPa) at normal operating speeds and whenever the fuel pressure at the inlet fitting falls to the minimum fuel pressure of 6 inches of mercury (20.3 kPa).

Item 13 — Water Pump and Coolant Inhibitor Element

The water pump drain hole should be inspected every 6 months to make sure it is open. A small chemical build up or streaking at the drain hole may occur. This is not an indication of a defective water pump or seal. Remove the build-up with a mild detergent cleaner and a brush. If coolant does not leak from the drain hole under normal operating conditions, do not replace the water pump.

If the cooling system is protected by a coolant inhibitor element (see Figure 17), the coolant must be tested at required intervals and the element replaced, if required. Refer to "Coolant Test Intervals" chart and "Inhibitor Test Procedures" under **How to Select Coolant** for required test intervals and inhibitor levels. Use the coolant element part number listed in Table 24 in the Specifications section. The valves mounted on the adapter head **must** be opened after the element is replaced.

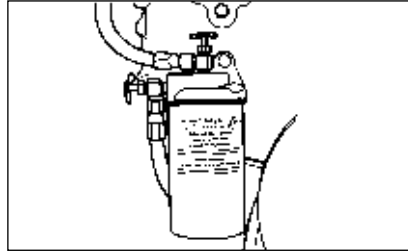


Figure 17. Coolant Inhibitor Element

Item 14 — Cranking Motor

For information, contact an authorized Delco-Remy® or Bosch® Service Center, depending on manufacturer.

Item 15 — Air System

All the connections in the air system should be checked to make sure they are tight and leak free. Check all hoses and ducting for punctures, deterioration or other damage and replace, if necessary.

Item 16 — Exhaust System

Have the exhaust manifold retaining bolts and other connections checked for tightness. Also have the exhaust pipe rain cap checked for proper operation, if so equipped.

Item 17 — Engine (Steam Clean)

Steam clean the engine and engine compartment every 60,000 miles (96,000 km) or 2,000 hours, whichever comes first.

NOTICE:

Do not apply steam or solvent directly on the battery-charging alternator, starting motor, DDEC components, sensors, or other electrical components, as damage to electrical equipment may result.

Item 18 — Radiator

The exterior of the radiator core should be inspected every 12 months (300 hours for industrial applications) or 30,000 miles (48,000 km) and, if necessary, cleaned with a quality grease solvent, such as mineral spirits, and dried with compressed air. **Fuel oil, kerosene or gasoline should not be used.**



CAUTION:

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 40 psi (276 kPa) air pressure.

It may be necessary to clean the radiator more frequently if the engine is being operated in extremely dusty or dirty areas.

If a Low Coolant Level Sensor is installed in the top tank of the radiator, it should be tested for proper operation every 12 months or 100,000 miles (160,000 km), whichever comes first. Authorized Detroit Diesel distributors are properly equipped to perform this service.

Item 19 — Oil Pressure

Under normal operation, oil pressure is noted each time the engine is started. In the event the equipment is equipped with warning lights rather than pressure indicators, the pressure should be checked and recorded every 60,000 miles (96,000 km) for vehicle engines or 600 hours for stationary or industrial engines.

Item 20 — Battery-Charging Alternator

Terminals should be checked for corrosion and loose connections and wiring inspected for damaged or frayed insulation. Have wiring repaired or replaced, as required.

Check torque on alternator mounting bolts and retighten, if necessary.

Precautions must be taken when working on or around the alternator. The diodes and transistors in the alternator circuit are very sensitive and can be easily destroyed.

1. Avoid grounding the output terminal. Grounding an alternator's output wire or terminal (which is always hot, regardless of whether or not the engine is running) and accidentally reversing the battery polarity will result in equipment damage.
2. Do not reverse battery connections. This can also cause damage.



CAUTION:

To avoid injury from battery explosion or contact with battery acid, work in a well-ventilated area, wear protective clothing, and avoid sparks or flames near the battery. Always establish correct polarity before connecting cables to the battery or battery circuit. If you come in contact with battery acid:

- Flush your skin with water.
- Apply baking soda or lime to help neutralize the acid.
- Flush your eyes with water.
- Get medical attention immediately.

3. Never disconnect the battery while the alternator is operating. Disconnecting the battery can result in damage to the alternator diodes. In applications which have two sets of batteries, switching from one set to the other while the engine is running will momentarily disconnect the batteries. This can result in equipment damage.
4. If a booster battery is to be used, batteries must be connected correctly (negative to negative, positive to positive) to avoid equipment damage.

5. Never use a fast charger with the batteries connected or as a booster for battery output.

For information on the alternator assembly, contact an authorized Delco-Remy® or Bosch® distributor, depending on manufacturer.

Item 21 — Engine and Transmission Mounts

The engine and transmission mounting bolts and the condition of the mounting pads should be checked every 600 hours or 60,000 miles (96,000 km) and tightened and/or repaired as necessary.

Item 22 — Crankcase Pressure

The crankcase pressure should be checked and recorded every 600 hours or 60,000 miles (96,000 km).

Item 23 — Fan Hub

If the fan bearing hub assembly has a grease fitting, use a hand grease gun and lubricate the bearings with one shot of quality lithium-base multi-purpose grease every 100,000 miles (160,000 km) for vehicle engines or 1,000 hours for non-vehicle engines. Care should be taken not to overfill the housing.

Item 24 — Thermostats and Seals

Replace the thermostats and seals every 240,000 miles (384,000 km) on vehicle engines. On non-vehicle engines replace every 4,000 hours or 24 months, whichever comes first.

Item 25 — Crankcase Breather

The internally mounted (in the engine rocker cover) crankcase breather assembly should be removed every 100,000 to 120,000 miles (160,000 to 192,000 km) (vehicle engines) or every 1,000 hours (non-vehicle engines) and the steel mesh pad washed in clean fuel oil. This cleaning period may be reduced or lengthened according to the severity of service.

The rocker cover-mounted breather assembly (part number 23512984) used in the closed crankcase breather system should be *replaced* every 4000 engine operating hours. It is not reusable and no attempt should be made to clean or reuse it.

Item 26 — Engine Tune-up

There is no scheduled interval for performing an engine tune-up. However, the valve lash and injector heights on all Series 60 engines *must* be measured and , if necessary, adjusted at the initial period listed in Table 10.

Engine Application	Initial Valve Lash and Injector Height Measurement/ Adjustment Period
Vehicle Engines	60,000 miles (96,000 km) or 24 months*
Stationary, Construction/Industrial, Agricultural Machinery, or Generator Set Engines	1,500 Hours or 45,000 Miles (72,000 km)*

*Whichever comes first.

Table 10. Valve Lash and Injector Height Adjustment

Once the initial measurements/adjustments have been made, any adjustment beyond this point should be made only as required to maintain satisfactory engine performance.

Item 27 — Vibration Damper

The viscous vibration damper should be inspected periodically and replaced if dented or leaking. Heat from normal engine operation may, over a period of time, cause the fluid within the viscous vibration damper to break down and lose its dampening properties. For this reason, the viscous vibration damper *must* be replaced at time of normal major engine overhaul, regardless of apparent condition.

Welding Precaution

NOTICE:

To prevent damage to the DDEC electronic control system, disconnect battery power and ground cables and the power connector at the ECM (electronic control module) before welding. **Failure to isolate the DDEC system from high current flow can result in severe ECM damage.**

"HOW TO" SECTION

This section covers Detroit Diesel's recommendations on how to select lubricating oil, fuel oil, and coolant and includes basic engine maintenance procedures which can be performed by the operator.

NOTICE:

The manufacturer's warranty applicable to Series 60 engines provides in part that the provisions of such warranty shall not apply to any engine unit that has been subject to misuse, negligence or accident. Accordingly, malfunctions attributable to neglect or failure to follow the manufacturer's fuel or lubricating recommendations may not be within the coverage of the warranty.

A. How to Select Lubricating Oil

Lubricant Selection in North America

The selection of the proper lubricating oil is important to achieve the long and trouble-free service which Detroit Diesel engines are designed to provide. The

proper lubricating oil for all Detroit Diesel engines is selected based on SAE viscosity grade and API (American Petroleum Institute) service designation. Only oils licensed to display the American Petroleum Institute (API) symbol shown should be used. See Figure 18.

Lubricant Requirements



Figure 18. API Lubricant Service Mark

Lubricants meeting these criteria have provided maximum engine life when used in conjunction with specified oil drain and filter maintenance schedules.

API CF-4 or CG-4 oils may be used when CH-4 oils are not available; however, their use may require a reduction in oil drain interval depending upon the application and the fuel sulfur level.

At ambient temperatures below -20°C (-4°F) when sufficient starter speed cannot be achieved with SAE 15W-40 oils, the use of 5W-XX and 10W-XX oils, where XX is 30 or 40, is allowed to improve startability, provided they are API CG-4 and have demonstrated field performance in DDC engines. These oils must possess a HT/HS of 3.7 minimum. Monograde oils should not be used in Series 60 engines regardless of API Service Classification.

Synthetic Oils

Synthetic oils may be used in Detroit Diesel engines provided they are API licensed and meet the performance and chemical requirements of non-synthetic oils outlined in this publication. Synthetic oils offer improved low temperature flow properties and high temperature oxidation resistance. However, they are generally more costly than non-synthetic oils.

Product information about synthetic oils should be reviewed carefully. Performance additive systems often respond differently in synthetic oils. Their use does not permit extension of recommended oil drain intervals.

The Use of Supplemental Additives

Lubricants meeting the Detroit Diesel specifications outlined in this publication already contain a balanced additive treatment. Supplemental additives are generally not necessary and can even be harmful. These additives may be marketed as either oil treatments or engine treatments and are discouraged from use in Detroit Diesel engines. *Engine damage resulting from the use of such materials is not covered by your Detroit Diesel Corporation warranty.* Detroit Diesel will not provide statements beyond this publication relative to their use.

B. When to Change Oil

Oil Drain Intervals

The length of time an engine may operate before an oil change depends upon the lubricant and fuel used, engine oil consumption, and the operating cycle. The following table lists the **maximum interval** at which the engine may operate before the oil and filters must be changed. Oil analysis may be used to

determine whether this interval should be shortened, but should not be used to lengthen the interval.

The use of fuels with sulfur content above 0.5 mass percent will require a shortening of drain intervals and/or the use of a higher TBN oil. See the information listed in Table 11. For details refer to publication "Engine Requirements—Lubricating Oil, Fuel, and Filters" (7SE270), available from authorized Detroit Diesel Distributors.



CAUTION:

To avoid injury from contact with the contaminants in used engine oil, wear protective gloves and apron.



CAUTION:

To avoid injury from fire caused by heated lubricating-oil vapors:

- **Keep those people who are not directly involved in servicing away from the engine.**
- **Stop the engine immediately if an oil leak is detected.**
- **Do not allow open flames or smoke when working on an operating engine.**
- **Wear adequate protective clothing (face shield, insulated gloves, apron, etc.) to avoid burns.**
- **To prevent a buildup of potentially volatile vapors, keep the engine area well ventilated during operation.**

Lubricating oil is relatively harmless at ambient temperatures.

Engine Application	Drain Interval
Highway Truck & Motor Coach#	15,000 Miles (24,000 km)
City Transit Coach#	6,000 Miles (9,600 km), 300 hours, or 3 months, whichever comes first
Fire Truck or Crash/Rescue Vehicle#	6,000 Miles (9,600 km), 300 hours or 1 year, whichever comes first
Industrial, Agricultural	250 hours or 1 year, whichever comes first
Stationary Generator, Prime Power or Continuous	250 hours or 3 months, whichever comes first
Stationary Generator, Standby	150 hours or 1 year, whichever comes first

#Drain intervals shown apply to pre-1998 model year engines. 1998 and newer engines may require a modification to these intervals based on used oil analysis. Refer to publication, "Engine Requirements – Lubricating Oil, Fuel, and Filters" (7SE270), available from authorized Detroit Diesel Distributors.

Table 11. Maximum Oil Drain and Filter Change Interval (Fuel Sulfur 0.5 Weight Percent or Less)

Disposing of Waste Oil

Dispose of used lubricating oil and filters in an environmentally responsible manner, according to federal (EPA) and/or state recommendations. The disposal of waste oil may be best addressed by the engine oil supplier, who may accept responsibility for proper disposal of this material as part of the business of providing lubricant.

C. How to Replace the Lube Oil Filters

Filters are an integral part of the lubricating oil system. Proper filter selection and maintenance are important to satisfactory engine operation and service life. Filters should be used to maintain a clean system, not to clean up a contaminated system. Filter part numbers are listed in Table 19 in the Specifications section.

Replace Spin-on Type Oil Filter

1. Remove the spin-on filters using strap wrench tool J 29917 (or equivalent) and a 1/2" drive socket wrench and extension. See Figure 19.

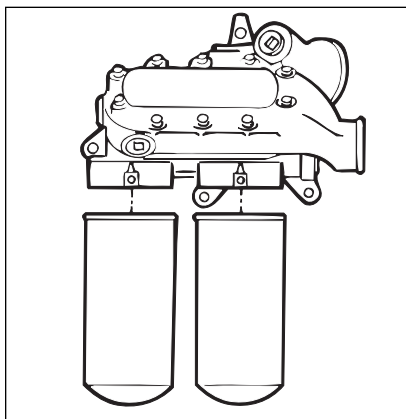


Figure 19. Spin-On Oil Filters

2. Dispose of the used oil and filters in an environmentally responsible manner according to state and/or federal (EPA) recommendations.
3. Clean the filter adapter with a clean, lint-free cloth.
4. Fill the new filters with clean lubricating oil, and lightly coat the filter gaskets (seals) with the same oil.
5. Start the new filters on the adapter and tighten by hand until the gaskets touch the mounting adapter head.
Tighten filters an additional two-thirds turn by hand.

NOTICE:
Overtightening may distort or crack the filter adapter.

6. Add oil as required to bring the level to the "full" mark on the dipstick.
7. Start and run the engine for a short period and check for leaks. After any leaks have been corrected, stop the engine long enough for oil from various parts of the engine to drain back to the crankcase (approximately 20 minutes). Add oil as required to bring the level to the proper mark on the dipstick.

NOTICE:
If the oil level is constantly above normal and excess lube oil has not been added to the crankcase, consult with an authorized Detroit Diesel service outlet for the cause. Fuel or coolant dilution of lube oil can result in serious engine damage.

D. How to Select Fuel Oil

Quality—Fuel quality is an important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels. Detroit Diesel engines are designed to operate on most diesel fuels marketed today.

In general, fuels meeting the properties of ASTM designation D 975 (grades 1-D and 2-D) have provided satisfactory performance.

The fuels used must be clean, completely distilled, stable, and non-corrosive. For more information regarding the significance of these properties and selection of the proper fuel, refer to publication "Engine Requirements—Lubricating Oil, Fuel, and Filters" (7SE270) available from authorized Detroit Diesel Distributors.

Fuel Contamination—Generally, fuel contamination occurs as the result of improper fuel handling. The most common types of contamination are water, dirt, and microbial growth (“black slime”). The formation of varnishes and gums resulting from poor stability or extended storage (“stale fuel”) also affects fuel quality. The best treatment for contamination is prevention by maintaining a clean storage system and choosing a reputable fuel supplier.

Supplemental additives are *not recommended* due to potential injector system or engine damage. Our experience has been that such additives increase operating costs without providing benefit.

The use of supplemental fuel additives does not necessarily void the engine warranty. **However, repair expenses which result from fuel system or engine component malfunctions or damage attributed to their use will not be covered.** These products should be accompanied by performance data supporting their merit. It is not the policy of Detroit Diesel Corporation to test, evaluate, approve, or endorse such products.

Prohibited Additives

The following Fuel Additives are NOT allowed and MUST NOT be mixed with diesel fuel:


Used Lubricating Oil—Detroit Diesel specifically prohibits the use of drained lubricating oil in diesel fuel. Used lubricating oil contains combustion acids and particulate materials which can severely erode fuel injector components, resulting in loss of power and increased exhaust emissions. In addition, the use of drained lubricating oil will increase maintenance requirements due to filter plugging and combustion deposits.


Gasoline—



CAUTION:

The addition of gasoline to diesel fuel will create a serious fire hazard.

 CAUTION:
<p>To avoid injury from fire caused by heated diesel-fuel vapors:</p> <ul style="list-style-type: none"> ■ Keep those people who are not directly involved in servicing away from the engine. ■ Stop the engine immediately if a fuel leak is detected. ■ Do not allow open flames or smoke when working on an operating engine. ■ Wear adequate protective clothing (face shield, insulated gloves and apron, etc.). ■ To prevent a buildup of potentially volatile vapors, keep the engine area well ventilated during operation. <p>Diesel fuel is relatively harmless at ambient temperatures.</p>

 CAUTION:
<p>To avoid injury from fire, keep all potential ignition sources away from diesel fuel, including open flames, sparks, and electrical resistance heating elements. Do not smoke when refueling.</p>

The presence of gasoline in diesel fuel will reduce fuel cetane number and increase combustion temperatures. Tanks which contain such mixtures should be drained and cleaned as soon as possible.

Detroit Diesel Corporation will not be responsible for any detrimental effects which it determines resulted from adding drained lubricating oil or gasoline to the diesel fuel.

For more detailed information on fuel selection, refer to "Engine Requirements—Lubricating Oil, Fuel, and Filters" (form 7SE270), available from authorized Detroit Diesel service outlets.

E. How to Replace the Fuel Filters

Filters are an integral part of the fuel system. Proper filter selection and maintenance are important to satisfactory engine operation and service life. Filters should be used to maintain a clean system, not to clean up a contaminated system. Refer to **Specifications** (Table 19) for proper filter selection.

Spin-on type primary and secondary fuel filters are used on Series 60 engines. The spin-on type consists of a shell, element, and gasket unitized into a single cartridge and a filter cover which includes a threaded sleeve to accept the spin-on filter cartridge. An optional fuel/water separator may be installed in place of the standard primary filter.

Replace Spin-on Type Primary or Secondary Filter Elements

1. With the engine shut down, place a suitable container under the filter.
2. A fuel shutoff valve may be installed on the discharge side of the secondary fuel filter. If installed, turn the handle on the shutoff valve to the **closed** position (perpendicular to the valve).
3. Using a suitable band type filter wrench, remove the primary and secondary fuel filters. See Figure 20. Dispose of the filters in an environmentally responsible manner, according to state and/or federal (EPA) recommendations.
4. Fill new replacement filters with clean fuel oil and coat the gaskets lightly with clean fuel oil.

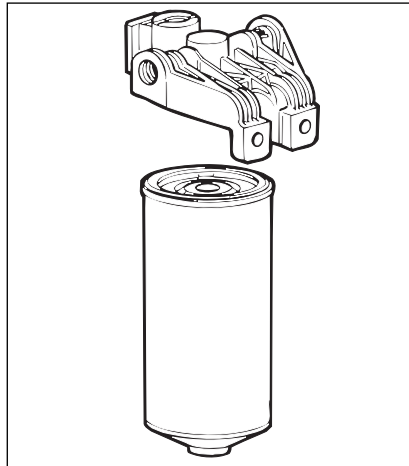


Figure 20. Typical Spin-On Type Fuel Filter

5. Thread the new filters onto the adapters until they make full contact with the gasket and no side movement is evident. Then rotate an additional one-half turn **by hand** or tighten per instructions printed on the filter.

NOTICE:

Overtightening may crack or distort the adapters.

6. Turn the handle on the shutoff valve (if installed) to the **open** position (in line with the valve).
7. Start the engine and check for leaks.

NOTICE:

To improve engine starting, have replacement filters filled with fuel and ready to install immediately after used filters are removed. This will prevent possible siphoning and fuel system aeration.

If the engine fails to start after filter replacement, the fuel system will require priming with tool J 5956 (or equivalent). Authorized Detroit Diesel service outlets are properly equipped to perform this service.

NOTICE:

Under no circumstances should the starting motor and fuel pump be used to prime the fuel filters. Prolonged use of the starting motor and fuel pump to prime the fuel system can result in damage to the starter, fuel pump, and injectors and cause erratic running of the engine due to the amount of air in the lines and filters.

Replace Fuel/Water Separator

If an optional primary filter/water separator is installed, replace the element as follows:

1. Drain off some fuel by opening the drain valve.
2. Using a strap wrench, remove the element and bowl together, then remove the bowl from the element. The filter and bowl have standard right-hand threads, so turn counter-clockwise to remove.
3. Clean the bowl and the O-ring seal.
4. Apply a light coating of clean fuel or grease to the O-ring seal, spin the bowl onto the new filter, and *tighten by hand*.

NOTICE:

To avoid damaging the bowl or the filter, do not use tools when tightening.

5. Apply a light coating of clean fuel or grease to the new O-ring seal on the top of the filter. Spin the filter and bowl assembly onto the filter head, and *tighten by hand* until snug.
6. To eliminate air from the filter, operate the primer pump on the filter head (if equipped) until the fuel purges at the filter assembly.
7. Start the engine and check for leaks. Correct any leaks with the engine off.

Replace "Fuel Pro® 380/380E" Fuel Filter Element

The Fuel Pro 380/380E diesel fuel filter system consists of a permanently mounted fuel processor, a replaceable

filter element and sealing grommet assembly, a filter spring, a see-thru cover and seal, a cover collar, and a vent cap and seal. The Fuel Pro 380E system also includes a fuel heater element, thermostatic switch, and wiring harness. See Figure 21.

1. With the engine shut down and cool, place a suitable container under the fuel processor.
2. A fuel shutoff valve may be installed on the discharge side of the fuel filter. If installed, turn the handle on the shutoff valve to the closed position (perpendicular to the valve).

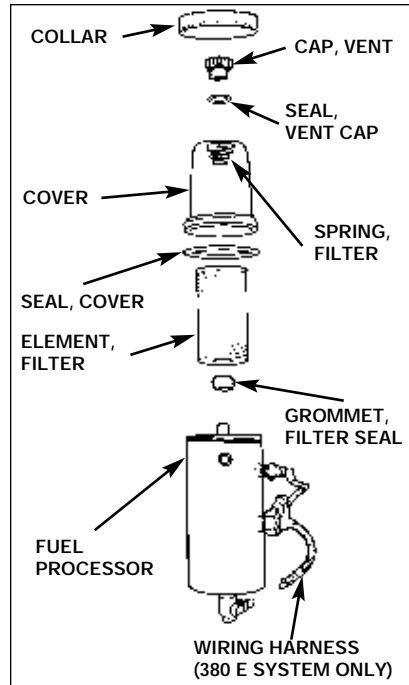


Figure 21. Fuel Pro 380E Fuel Processor Assembly

3. Open the drain valve at the base of the fuel processor, and drain the fuel until it is below the level of the filter. Close the drain valve. The fuel may be returned to the tank.
4. Using filter collar wrench 23516731 or equivalent, remove the collar by turning counter-clockwise. Remove the cover, filter spring, and cover seal ring by lifting straight up and over the filter element. Remove the element from the center stud (fuel outlet pipe) by pulling upward and twisting slightly.

NOTE:

Current filter elements include an integral sealing grommet. Former filter elements used a separate sealing grommet. If a former element is replaced, make sure the separate sealing grommet is removed from the center stud.

5. Dispose of the used filter element and grommet in an environmentally responsible manner, according to state and/or federal (EPA) recommendations.
6. Check to make sure a sealing grommet is included in the base of the replacement element, then install the element onto the center stud.
7. Check to make sure the filter spring is installed at the top of the cover. If missing, this spring must be replaced to insure proper filter operation. Wipe the cover lip and cover seal clean. After making sure the seal is properly positioned at the base of the cover, install the cover and collar onto the fuel processor. Tighten the collar by hand until secure.

NOTICE:

Do not use a wrench of any kind to tighten the collar, since this may lead to overtightening which can damage the collar and/or the cover.

8. Remove the vent plug from the top of the cover by turning the plug counter-clockwise. Fill the cover full of clean fuel. After making sure the O-ring seal is installed on the vent plug, reinstall the plug and tighten by hand only.

NOTICE:

To avoid cover or vent plug damage, do not use tools to tighten the vent plug.

9. Open the fuel shutoff valve (if installed) and start the engine. When the lubrication system reaches its normal operating pressure, increase engine speed to high idle for 2 to 3 minutes.

NOTICE:

Do not allow the fuel level in the see-through cover to fall below the top of the collar, since this may lead to interruption of the fuel flow and engine stalling.

10. After the air is purged and with the engine still running, loosen the vent cap. The fuel level in the cover will start falling. When the fuel level falls to the top of the collar, tighten the vent cap quickly by hand.
11. Shut down the engine and hand tighten the collar again.

NOTICE:

Do not use a wrench of any kind to tighten the collar, since this may lead to overtightening which can damage the collar and/or the cover.

12. Restart the engine and check for leaks.

NOTE:

The clear filter cover will not fill completely during engine operation. It will gradually fill over time, and the fuel level will rise as the filter medium becomes clogged. The filter element does not require changing until the fuel level has risen to the top of the element, or after one year of service, whichever comes first.

F. Engine Out of Fuel— How to Restart

When an engine has run out of fuel, there is a definite procedure to follow when restarting it.

1. Fill the fuel tank with the recommended grade of fuel. If only partial filling is possible, add a minimum of 10 gallons (38 liters) of fuel to the tank.
2. Close the fuel shutoff valve (if installed) and remove the spin-on fuel filters. Fill with clean fuel through the fuel inlet holes (the outer ring of small holes) to insure the fuel is filtered. Thread elements onto the adapters until they make full contact with the gasket and no side movement is evident. Then rotate an additional one-half turn by hand or tighten per instructions printed on the filter.

3. Open the fuel shutoff valve (if installed). Start engine, and check filters for leaks.

4. If a Fuel Pro 380 filter is installed, remove the vent plug from the top of the cover by turning the plug counterclockwise. Fill the cover *full* of clean fuel. After making sure the O-ring seal is installed on the vent plug, reinstall the plug and *tighten by hand only*.

NOTICE:

To avoid cover or vent plug damage, do not use tools to tighten the vent plug.

NOTICE:

Do not allow the fuel level in the see-through cover to fall below the top of the collar, since this may lead to interruption of the fuel flow and engine stalling.

5. Start the engine and allow the lubrication system to reach its normal operating pressure, then increase engine speed to high idle for 2 to 3 minutes. After the air is purged and with the engine still running, loosen the vent cap on the filter cover. The fuel level in the cover will start falling. When the fuel level falls to the top of the collar on the Fuel Pro cover, tighten the vent cap quickly.

NOTE:

If the engine fails to start after replacement of fuel filters, the fuel system will require priming with tool J 5956 (or equivalent). Authorized Detroit Diesel service outlets are properly equipped to perform this service.

NOTICE:

Under no circumstances should the starting motor and fuel pump be used to prime the fuel filters. Prolonged use of the starting motor and fuel pump to prime the fuel system can result in damage to the starter, fuel pump, and injectors and cause erratic running of the engine due to the amount of air in the lines and filters.

G. How to Select Coolant

This section covers selection of the required coolant for Series 60 engines. To help ensure more complete understanding of the information, the definitions of the following terms are provided:

Antifreeze — Ethylene Glycol or Propylene Glycol containing a corrosion inhibitor package and which meets an appropriate heavy-duty specification (i.e., TMC RP-329 for ethylene glycol or TMC RP-330 for propylene glycol).

Coolant — The fluid mixture circulating in the engine cooling system, typically a mixture of 50% water and 50% antifreeze.

Drop-Out — Precipitated sludge or deposit formation in or on cooling system components.

Fully Formulated Antifreeze — Contains all the necessary inhibitors to protect a diesel engine, and does not, therefore, require a pre-charge of SCA before its first use.

Initial-Fill Coolant — The coolant that is used in a new or rebuilt engine, or any time the cooling system is emptied and then refilled with new coolant.

NOAT — Nitrited Organic Acid Technology. An inhibitor system based on nitrite and organic acid inhibitors instead of traditional North American inhibitor formulations.

OAT — Organic Acid Technology. An inhibitor system based on organic acid inhibitors instead of traditional North American inhibitor formulations.

SCA — Supplemental Coolant Additives. (SCAs) are used in a preventive maintenance program to prevent corrosion, cavitation, and the formation of deposits.

APPROVED COOLANTS

The approved and preferred coolants for Series 60 engines are listed in Table 12. Once installed, these coolants should be maintained according to the procedures discussed under *Maintenance*.

NOTICE:
Required specifications for water, ethylene glycol, propylene glycol, inhibitor packages, and inhibitor concentration are included in this section. To avoid possible engine damage from inadequate or over-concentrated coolant, this information should be read thoroughly before the coolant is replaced.

Ethylene Glycol/Water + SCA Inhibitor/Propylene Glycol/Water + SCA Inhibitor

These products are available as fully formulated, Phosphate-Free, Extended Service Interval (ESI) coolants. They are commercially available from Detroit Diesel (recommended) and other manufacturers, as either a concentrated antifreeze or as a pre-mixed antifreeze. The pre-mixed antifreeze is ready for use, while the concentrated coolant must be mixed with water prior to use.

Coolant Fill Option	Product
Ethylene Glycol & Water + Corrosion Inhibitors ¹	DDC <i>Power Cool</i>
Commercial Equivalent of DDC <i>Power Cool</i>	Fully Formulated TMC RP-329 Type A Antifreeze & Water
Propylene Glycol & Water + Corrosion Inhibitors	Fully Formulated TMC RP-330 Type A Antifreeze & Water
Ethylene Glycol & Water+ NOAT Inhibitors	DDC <i>Power Cool Plus</i>
Water Only + Corrosion Inhibitors ²	Water + DDC <i>Power Cool</i> 3000
Water Only + NOAT Inhibitors ²	Water + DDC <i>Power Cool Plus</i> 6000

¹Preferred Coolant

²Water-only coolant systems offer no freeze protection and should not be used where ambient temperatures can fall to 32°F (0°C).

Table 12. Initial Fill Coolant Options

Detroit Diesel *Power Cool* Engine Coolant (P/N 23512138) is the preferred ethylene glycol coolant. If other commercial brands of ethylene glycol are used, they must be equivalent to the *Power Cool* (see next paragraph). Detroit Diesel does not market a propylene glycol coolant. If a propylene glycol coolant is used, it must also meet the requirements listed below.

Fully formulated ethylene glycol-based, low silicate antifreeze or coolant must meet TMC RP-329 "Type A" requirements. Fully formulated propylene glycol-based antifreeze or coolant must meet TMC RP-330 "Type A" requirements. Fully formulated antifreeze does not require a dosage of SCA prior to initial use.

Mixing EG or PG Antifreeze and Water

If a concentrated Ethylene Glycol (EG) or Propylene Glycol (PG) antifreeze is purchased, mix the antifreeze with water meeting the required quality standards listed in Table 15 and fill the cooling system.

If a pre-diluted, fully formulated coolant is purchased, simply fill the cooling system. For best overall performance, a coolant consisting of 50% concentration of antifreeze (50% antifreeze, 50% water) is *recommended*. An antifreeze concentration over 67% (67% antifreeze, 33% water) is *not recommended* due to poor heat transfer, reduced freeze protection (IEG only), and possible silicate dropout. An antifreeze concentration below 33% (33% antifreeze, 66% water) offers too little freeze and/or corrosion protection and is *not recommended*. See Figure 22 for ethylene glycol-based coolant concentration versus freezing and boiling temperatures. See Figure 23 for propylene glycol-based coolant concentration versus freezing and boiling temperatures. Always verify that the freeze point and nitrite concentration of the antifreeze/water mix are correct by using a PowerTrac™ 3-Way Coolant Test Strip. If chemical analysis is used, elements in the coolant must fall within the limits listed in Table 13.

Fully Formulated Glycol Coolant Concentration Limits	
Boron	125 - 500 PPM
Nitrite	800 - 2400 PPM
Nitrate	200 - 750 PPM
Silicon	50 - 250 PPM
Phosphate	0 PPM Max.
pH	8.0 - 10.5

Table 13. Fully Formulated Glycol Coolant Limits with TMC RP-329, RP-330 Chemistry Type A (50/50 Coolant/Water Mixture)

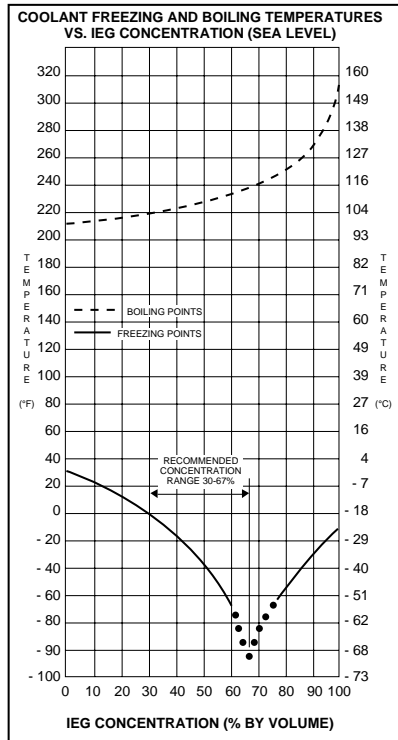


Figure 22. Coolant Freezing and Boiling Temperatures vs. Inhibited Ethylene Glycol (IEG) Concentration (Sea Level)

Recycled Antifreeze

Antifreeze or coolant recycled by reverse osmosis, distillation, and ion exchange, properly re-inhibited to meet TMC RP-329 Type A or RP-330 Type A requirements has been demonstrated to provide service equivalent to virgin antifreeze. Recycled antifreeze or coolants of these types are preferred. Other recycled coolants, especially coolants recycled through filtration processes, are not recommended.

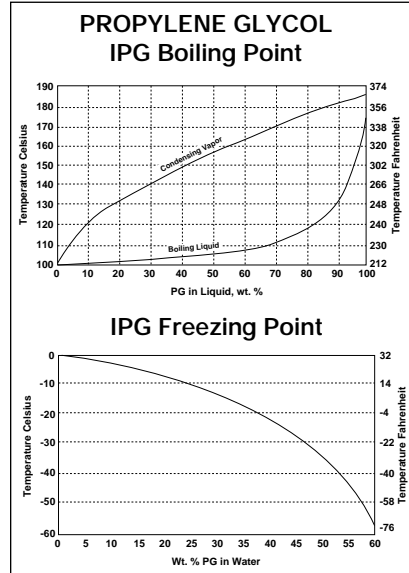


Figure 23. Coolant Freezing and Boiling Temperatures vs. Inhibited Propylene Glycol (IPG) Concentration (Sea Level)

Ethylene Glycol / Water + NOAT Inhibitor Propylene Glycol / Water + NOAT Inhibitor

Ethylene glycol and propylene glycol are also available with a Nitrited Organic Acid Technology (NOAT) corrosion inhibitor package. These coolants require less maintenance over the useful life of the engine. NOAT coolants, maintained as detailed in the *Maintenance* section, may be operated up to 4 years, 600,000 miles, (960,000 km), or 10,000 operating hours, whichever comes first. The cooling system should either be equipped with a "blank" coolant filter or the coolant filter and piping may be omitted from the system.

NOAT fully formulated antifreezes are available as concentrated and pre-mixed. Concentrated antifreezes should be mixed at 50% (50% antifreeze/50% water). NOAT coolants should not be mixed with conventional coolants. If they are mixed, no damage will result, but the long-life advantages of the NOAT coolant will be lost. In this event, the coolant should be maintained as a fully formulated EGI coolant, not as an OAT coolant.

Detroit Diesel markets a NOAT inhibited ethylene glycol coolant, DDC *Power Cool Plus*. *Power Cool Plus* contains all of the required additives. If a non-DDC NOAT antifreeze is used, it must conform to TMC 338 specification. *Do not add extender to new NOAT antifreeze or coolant.*

**Water Only + SCA
Water Only + NOAT Inhibitor**

In *warm climates* a coolant based on water with corrosion inhibitors is approved for use. Water-only systems need to be treated with the proper

dosage of corrosion inhibitors. Detroit Diesel-approved SCAs or NOAT corrosion inhibitors *must* be added to the water to provide required corrosion and cavitation erosion protection. NOAT inhibitors such as *Power Cool Plus 6000* are available for water-only systems. Inhibitor should be mixed at 7.5% (pending) by volume with water. *Power Cool* products are listed in Tables 21 thru 30. Traditional SCA (*Power Cool 3000*) can also be used to protect the engine. *Power Cool 3000* coolant concentration limits are listed in Table 14.

NOTE:

Do not use Power Trac 3-Way Test Strips to test NOAT coolant.

Power Cool 3000 SCA inhibitors should be mixed at 5% by volume with water. This is 1 quart per 5 gallons of water. These additions can be made by adding liquid SCAs available in a variety of sizes. Coolant filters are also available for different cooling system capacities. These filters release the proper amount of SCA at initial fill.

Power Cool 3000 Coolant Concentration Limits	
Boron	125 - 500 PPM
Nitrite	800 - 2400 PPM
Nitrate	0 - 750 PPM
Silicon	50 - 400 PPM
Phosphate	0 PPM Max.
pH	8.0 - 11.0

Table 14. *Power Cool 3000 Concentration Limits (5% Power Cool 3000/95% Water)*

Water Requirements

Distilled, reverse osmosis purified, or de-ionized water which eliminates the adverse effects of minerals in tap water is preferred. High levels of dissolved chlorides, sulfates, magnesium, and calcium in some tap water causes scale deposits, sludge deposits and/or corrosion. These deposits been shown to result in water pump failures and poor heat transfer, resulting in over-heating. If tap water is used, the mineral content in the water must be below the maximum allowable limits listed in Table 15.

	Maximum Allowable	
	Parts per Million	Grains per Gallon
Chlorides	40*	2.5
Sulfates	100*	5.8
Total Dissolved Solids	340	20
Total Hardness Magnesium & Calcium	170	10

* Limits Currently Under Review

Table 15. Satisfactory Water Limits

NOTICE:
Do not add additional SCA to new, fully formulated antifreeze or coolant. This can result in dropout and/or the formation of deposits.

COOLANTS NOT RECOMMENDED

The following coolants are *not recommended* for use in Series 60 engines:

1. **All antifreezes and coolants containing phosphate** should be avoided. Drop out, overheating, and water pump seal failures can result from use of coolant or inhibitor packages based on phosphate.
2. **Automotive type coolants** generally contain high levels of phosphate and silicate, offer no liner pitting protection, and are *not suitable* for use in Detroit Diesel engines.
3. **Methyl alcohol-based antifreeze** must not be used because of its effect on the non-metallic components of the cooling system and its low boiling point.
4. **Methoxy propanol-based antifreeze** must not be used because it is not compatible with fluoroelastomer seals found in the cooling system.
5. **Glycol-based coolants formulated for heating/ventilation/air conditioning (HVAC)** should not be used. These coolants generally contain high levels of phosphates, which can deposit on hot internal engine surfaces and reduce heat transfer.

ADDITIVES NOT RECOMMENDED

The following additives are *not recommended* for use in Series 60 engines:

1. **Soluble oil additives** are not approved for use in Detroit Diesel engine cooling systems. A small amount of oil adversely affects heat transfer. For example, a 1.25% concentration of soluble oil increases the fire deck temperature 6%. A 2.50% concentration increases the fire deck temperature 15%. The use of soluble oil additives may result in engine overheating and/or failure.
2. **Chromate additives** are not approved for use in Detroit Diesel engine cooling systems. Chromate additives can form chromium hydroxide, commonly called "green slime." This, in turn, can result in engine damage due to poor heat transfer. Cooling systems operated with chromate-inhibited coolant must be chemically cleaned with *Power Cool* Dry Chemical cooling system cleaner/conditioner (or equivalent sulfamic acid/sodium carbonate cleaner) and flushed.

MAINTENANCE

Coolant Inhibitor Test Intervals

Coolant inhibitor level should be checked at the intervals listed in Table

Service Application	Inhibitor Test Interval
On Highway Trucks and Motor Coaches	20,000 Miles (32,000 Kilometers)
City Transit Coaches, Pick-up and Delivery Short Trip, and Emergency Vehicles	6,000 Miles (9,600 Kilometers) or three months, whichever comes first
Industrial, Continuous Duty Generator Set, and all Other Applications	500 Hours or three months, whichever comes first
Stand-by Generator Set	200 Hours or yearly, whichever comes first

Table 16. Required Coolant Inhibitor Test Intervals

16. If topping off is needed, add coolant which is identical to the initial fill coolant.

Supplemental Coolant Additives for Fully Formulated Coolant

The concentrations of some inhibitors will gradually deplete during normal engine operation. SCAs replenish the protection for cooling system components. The coolant *must* be maintained with the proper concentration of SCA. Detroit Diesel *Power Cool* maintenance SCAs are recommended. The proper application of SCA will provide:

- pH control.
- Restored inhibitor levels to prevent corrosion.
- Water-softening to deter formation of mineral deposits.
- Cavitation protection to protect wet sleeve cylinder liners.

NOTICE:

Failure to properly maintain coolant with SCA can result in damage to the cooling system and its related components. Conversely, over-concentration of SCA inhibitor can result in poor heat transfer, leading to engine damage. Always maintain concentrations at recommended levels. *Do not use traditional SCAs with NOAT coolant.*

Check the nitrite concentration at the regular intervals listed in Table 17 with a PowerTrac 3-Way Test Strip. Nitrite levels *must* be within the ranges listed in Table 13. Additional SCA *must* be added to the coolant when it becomes depleted, as indicated by a nitrite con-

centration of 800 PPM or less. *If the nitrite concentration is greater than 800 PPM, do not add additional SCA.* If the nitrite concentration is above 2400 PPM, the system is over-inhibited and should be partially drained and filled with a 50/50 mix of water and EG or PG.

Coolant	Interval ¹	Action
Antifreeze/Water + SCA Inhibitor (DDC <i>Power Cool</i>)	A 20,000 miles, (32,000 km), or 3 mos.* B 500 hours or 3 mos.*	Test nitrite concentration with test strip. Add SCA or dilute coolant as needed.
	A 300,000 miles (480,000 km) B 2 years or 4,000 hours*	Drain and clean system. Replace w/ new coolant.
Ethylene Glycol/Water + SCA Inhibitor or Propylene Glycol/Water + SCA Inhibitor	A 20,000 miles, (32,000 km), or 3 mos.* B 500 hours or 3 mos.*	Test nitrite concentration with test strip. Add SCA dilute coolant as needed.
	A 300,000 miles (480,000 km) B 2 years or 4,000 hours*	Drain and clean system. Replace w/ new coolant.
Ethylene Glycol/Water + NOAT Inhibitor or Propylene Glycol/Water + NOAT Inhibitor	A 300,000 miles, (480,000 km), or 2 yrs.* B 5,000 hours	Add <i>Power Cool Plus</i> Extender
	A 600,000 miles, (960,000 km) B 4 years, or 10,000 hours*	Drain and clean system. Replace w/ new coolant.
Water Only + SCA Inhibitor	A 20,000 miles, (32,000 km), or 3 mos.* B 500 hours or 3 mos.*	Test nitrite concentration with test strip. Add SCA or dilute coolant as needed.
	A 300,000 miles (480,000 km) B 2 years or 4,000 hours*	Drain and clean system. Replace w/ new coolant.
Water only + NOAT Inhibitor	A 300,000 miles, (480,000 km) or 2 yrs.* B 5,000 hours	Add <i>Power Cool Plus</i> Extender
	A 600,000 miles, (960,000 km) B 4 years or 10,000 hours*	Drain and clean system. Replace w/ new coolant

¹ Maintenance interval based on application. Drain interval dependent on proper maintenance.

A. On Highway Trucks and Motor Coaches, City Transit Coaches, Pick up and Delivery, Short Trip, and Emergency Vehicles

B. Industrial, Generator Set, and other applications

*Whichever comes first

Table 17. Coolant Maintenance Intervals

In this case the EG or PG should contain no inhibitors, and should conform to ASTM D4985. This will dilute the over-concentrated inhibitors.

NOTE:

In non-NOAT systems, nitrite concentration of 3000 PPM or higher on a Series 60 engine suggests problematic additive over-concentration. This condition *must* be corrected by immediate draining and flushing of the cooling system. Refill the system with new fully formulated or pre-charged coolant. Check the nitrite concentration level at the next maintenance interval with a PowerTrac 3-Way Test Strip.

SCA TEST PROCEDURES

Detroit Diesel PowerTrac 3-Way Coolant Test Strips should be used to measure nitrite and glycol concentrations. Refer to Table 30 in the Specifications section for part numbers. Cavitation/corrosion protection is indicated on the strip by the level of nitrite concentration. Freeze/boil-over protection is determined by glycol concentration. Use the test strips as follows:

1. Dip the strip into coolant for one second. Remove and shake briskly to eliminate excess fluid.
2. Immediately compare end pad (% Glycol) to the color chart on the container.
3. Sixty seconds (one minute) after dipping, compare the nitrite pad to the color chart.

4. Color change of additive indicator (middle pad) indicates presence of inhibitor that is not approved by Detroit Diesel.

For best results make the tests while the coolant is between 50° - 140°F (10.0° - 60°C). Wait at least 60, but not longer than 75, seconds before reading the nitrite level. Promptly replace and tighten the test strip container cap after each use. Discard unused strips if they have turned light pink or tan.

A factory coolant analysis program is available through authorized Detroit Diesel service outlets. Refer to Table 30 in the Specification section for part numbers. To verify coolant acceptability, submit a sample for coolant analysis every three (3) years, 300,000 miles, (480,000 km), or 6,000 operating hours, whichever comes first.

NEED RELEASE COOLANT FILTERS (NON-NOAT SYSTEMS)

Spin-on coolant filters are available for Detroit Diesel engines. Membranes in the filters release SCAs before the coolant approaches a corrosive condition, protecting the engine from corrosion. The elements release the SCA charge as needed, as opposed to the maintenance SCA elements, which instantaneously release the SCA charge. These elements should be replaced after 1 year, 120,000 miles, (192,000 km), or 2,000 operating hours, whichever comes first.

DROPOUT

Excessive amounts of some inhibitors in the engine coolant can cause a gel or crystalline deposit that reduces heat transfer and coolant flow. The deposit, called "dropout," takes the color of the coolant when wet, but appears as a white or gray powder when dry. It can pick up solid particles in the coolant and become gritty, causing excessive wear of water pump seals and other cooling system components. The wet gel can be removed by using a non-acid (alkali) type heavy-duty cleaner such as Detroit Diesel *Power Cool* On-Line Cleaner (sodium nitrite/sodium tetraborate). Refer to Table 29 in the Specifications section for part numbers. If the gel is allowed to dry, it is necessary to disassemble the engine and clean it with a caustic solution or physically clean individual components.

COOLANT EXTENDER INHIBITOR ADDITIVE FOR "NOAT" COOLANT

The inhibitors in NOAT coolant must also be maintained, but less often than traditional SCA-type coolants. A portable test is available to test the levels of NOAT inhibitors in coolant. Where this is not used, fleet testing has determined that a NOAT coolant extender package should be added to the coolant at 300,000 miles, (480,000 km), 2 years, or 5,000 hours, whichever comes first. The proper maintenance dosages for all NOAT coolants are listed in Table 17, reflecting 0.6% by volume extender. This dosage should be added to the water-only and the glycol systems at the same interval.

The proper application of extender to NOAT coolant will provide:

- pH control.
- Restored inhibitor levels to prevent corrosion
- Cavitation protection to protect wet sleeve cylinder liners

NOTE:

Do not use traditional SCAs in NOAT coolant, and do not use NOAT extender in traditional coolants.

NOAT Coolant Drain Interval

A properly maintained NOAT-inhibited coolant will last 4 years, 600,000 miles, (960,000 km), or 10,000 operating hours, whichever comes first. At this time the coolant should be drained, and the cooling system should be thoroughly cleaned, flushed, and filled with new, properly inhibited NOAT coolant.

CHRONIC COOLANT SYSTEM PROBLEMS

The most commonly seen coolant system problems result from maintenance and formulation factors such as:

1. Hard Water
2. Dilution of the Coolant by the addition of Untreated Water.
3. Over Dosage or Under Dosage of Corrosion Inhibitors
4. Improper Corrosion Inhibitor (most often Phosphated)
5. Mixing SCAs
6. Improper Testing

DETROIT DIESEL
COOLING SYSTEM
MAINTENANCE PRODUCTS

Power Cool SCAs are water-soluble chemical compounds. These products are available in coolant filter elements, liquid packages, and in fully formulated *Power Cool* antifreeze.

NOTE:

Power Cool 3000 liquid SCA is more compatible with hard water than Power Cool 2000 SCA.

Power Cool Coolant Filter Elements (spin-on canisters) are available in various sizes suitable for cooling systems of varying capacity. Selection of the proper element size is vital when pre-charging non-fully formulated coolant (i.e. water) at initial fill and at maintenance intervals. A fully formulated antifreeze must NOT have SCA added at initial fill. Do not use SCA-containing filters with NOAT antifreeze or coolant. The need for maintenance elements is determined by the results of the nitrite concentration test performed at each cooling system service interval. *Do not automatically install maintenance elements at maintenance intervals unless the nitrite concentration level falls below 800 parts per million.*

Power Cool Liquid On-Line Cleaner is used for light deposits. **Power Cool Dry Chemical Cleaner/Conditioner** is used for heavy deposits or scale.

Summary of Coolant
Recommendations



CAUTION:

To avoid injury from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Remove the cap slowly to relieve pressure. Wear adequate protective clothing (face shield or safety goggles, rubber gloves, apron, and boots).

1. Always maintain the engine coolant to meet Detroit Diesel specifications.
2. Only use water that meets the specifications listed in Table 15. Distilled, de-mineralized (reverse osmosis) or de-ionized water is preferred.
3. The proper dosage of inhibitors *must* be included in the coolant at initial fill for all Detroit Diesel engines. This dosage is usually included in the fully formulated antifreeze used, or it may need to be added if water alone or if less than 50% antifreeze is used. The user is urged to refer to the full text of this section to determine the proper dosage. Mixing of different manufacturers' technologies (brands) could cause cooling system problems.

4. Maintain the inhibitor at the prescribed concentration. Test the nitrite concentration by using a titration kit or Detroit Diesel PowerTrac 3-Way Coolant Test Strips. Add SCA only if the nitrite concentration is below 800 PPM. *Do not use SCA in NOAT coolant, and do not use PowerTrac 3-Way Test Strips to test NOAT coolant.*

NOTE:

If the nitrite concentration exceeds 2,400 PPM, the coolant must be drained and replaced with new coolant. A thorough cleaning of the cooling system may be required.

5. Do not use another manufacturer's test kit to measure the SCA concentration of Detroit Diesel Maintenance Products.
6. Pre-mix coolant makeup solutions to the proper concentration before adding to the cooling system.
7. Do not mix NOAT and other coolants in the same engine.
8. Do not use automotive coolants or coolants with phosphates.
9. Where antifreeze/boil over protection is required, use only antifreeze that meets TMC RP-329 (EG) "type A" or TMC RP-330 (PG) "type A" specifications. Always maintain coolant at the proper level.

10. Coolant Life:

- Glycol Coolant. A *properly maintained* cooling system, filled with phosphate-free coolant consisting of a 50/50 mix of antifreeze and water per TMC RP-329 "Type A" or TMC RP-330 "Type A" can be operated for the life of the engine, until overhaul. The proper maintenance involves periodic evaluation using PowerTrac 3-Way Test Strips and addition of SCA as needed, indicated by the strip test. To verify coolant acceptability, submit a sample for coolant analysis every three (3) years, 300,000 miles, (480,000 km), or 5,000 operating hours, whichever comes first. Submit the sample in DDC Power Trac Coolant Test Bottle. Refer to Table 30 in the Specifications section for part numbers.

■ **NOAT Coolant.** A properly maintained NOAT coolant may be operated 4 years, 600,000 miles (960,000 km), or until overhaul, whichever comes first. At this time, the system *must* be completely drained, thoroughly cleaned, and refilled.

■ **NOAT Coolants** require the addition of an extender at 2 years, 300,000 miles, (480,000 km), or 5,000 hours, whichever comes first. Use 1 pint of extender for every 2 gallons of coolant.

■ **Other properly maintained coolants** may be operated up to 2 years, 250,000 miles, (400,000 km), or 4,000 operating hours, whichever comes first. At that time, the system must be completely drained, thoroughly cleaned, and refilled.

11. Do not use the following in Detroit Diesel engine cooling systems:

- Soluble oil
- High silicate, automotive type antifreeze
- Chromate SCA's
- Methoxy propanol-base coolant
- Methyl alcohol-base coolant
- Sealer additives or coolant containing sealer additives
- HVAC coolant
- Phosphated coolants

H. How to Drain and Flush the Cooling System



CAUTION:

To avoid injury from the expulsion of hot coolant, never remove the cooling system pressure cap while the engine is at operating temperature. Remove the cap slowly to relieve pressure. Wear adequate protective clothing (face shield or safety goggles, rubber gloves, apron, and boots).

1. With the engine cool, drain the previous solution from the engine and radiator. Dispose of the solution in an environmentally responsible manner according to state and/or federal (EPA) recommendations.
2. Refill the cooling system with clean, soft water and a good cooling system cleaning compound, such as those listed in Table 29. If the engine is warm, fill slowly to prevent the rapid cooling and distortion of the metal castings.
3. Start the engine and operate it for fifteen minutes to circulate the solution thoroughly.
4. Stop the engine and allow it to cool.
5. With the engine cool, drain the cooling system completely.
6. Refill the cooling system with clean, soft water and operate it for fifteen minutes.
7. Stop the engine and allow it to cool.

8. With the engine cool, drain the cleaner residue from the cooling system.
9. Refill the system with the required coolant. Refer to Section G.
10. Entrapped air must be purged after filling the cooling system. To do this, allow the engine to warm-up without the pressure cap installed. With the transmission in neutral, increase engine speed above 1000 RPM and add coolant as required.

Install the pressure cap after the coolant level has stabilized at the bottom of the radiator filler neck.

NOTICE:

If the engine overheats and the coolant level is satisfactory, the cooling system may require cleaning with a descaling solvent and backflushing. Authorized Detroit Diesel service outlets are properly equipped to perform these services.

In addition to the cleaning procedure, other components of the cooling system should be checked periodically to keep the engine operating at peak efficiency.

Hoses. Cooling system hoses should be inspected and any hose that shows obvious signs of damage or feels abnormally soft or hard should be replaced. Damaged clamps should be replaced. All external leaks should be corrected as soon as detected.

NOTE:


If Detroit Diesel **Power Cool** antifreeze/coolant (or equivalent fully formulated, precharged antifreeze) *is used*, a *precharge* element is not required. Coolant inhibitor levels *must* be checked at the intervals listed in Table 16.

I. When to Service the Dry Type Air Cleaner

Replace dry type air cleaner elements when the maximum allowable air cleaner restriction (20 inches of water or 5.0 kPa) has been reached, or annually, whichever comes first. Some air cleaners are equipped with a restriction indicator which aids in determining the servicing interval.

Cleaning and/or reusing dry paper type air cleaner elements is not recommended unless the cleaning method used removes clogging without damaging the element. Inspection and cleaning of elements *must* be done in accordance with the air cleaner manufacturer's recommendations, if any.

OBJECTIONABLE EXHAUST

	CAUTION:
<p>Diesel engine exhaust and some of its constituents are known to the state of California to cause cancer, birth defects and other reproductive harm.</p>	
<p>■ Always start and operate the engine in a well-ventilated area.</p>	
<p>■ If operating the engine in an enclosed area, vent the exhaust to the outside.</p>	
<p>■ Do not modify or tamper with the exhaust system or emission control system.</p>	

Probable Causes:

Damaged or dirty air cleaner
 Improper grade of fuel
 Excessive exhaust back pressure
 Misfiring cylinders
 Lubricating oil not burned in cylinder (being burned in exhaust manifold or turbocharger)
 Faulty injector setting
 Faulty oil control rings
 Excessive installation angle
 Excessive oil in crankcase
 High ambient air temperature
 Thin air (high altitude)
 Cetane rating of fuel too low
 Air in the fuel system

Black or Gray Smoke			
Blue Smoke			
White Smoke			
X			
X			
X			
		X	
	X		
X			
	X		
	X		
	X		
X			
X			
		X	
		X	

ABNORMAL ENGINE OPERATION

Probable Causes:

Misfiring cylinder
 Insufficient fuel
 High return fuel temperature
 Low compression
 DDEC malfunction
 High air inlet restriction/exhaust
 back pressure
 Engine application
 High air inlet temperature
 High altitude operation
 Incorrect engine gear train timing
 Low coolant temperature
 Oil picked up by inlet airstream
 Faulty injector operation
 Incorrect injector height setting

Rough Running or Frequent Stalling		
Low Power		
Detonation		
X	X	
X	X	
X	X	
X	X	
X	X	
	X	
	X	
	X	
	X	
	X	
		X
		X
		X
	X	X

ABNORMAL OPERATING CONDITIONS

Probable Causes:

Loose connections	X	
Cracked lines	X	
Damaged gaskets or seal rings	X	
*Lube oil loss at breather tube	X	
*Lube oil loss at dipstick tube	X	
*Indicates high crankcase pressure		
Leaking oil cooler	X	
Leaking valve stem seals	X	
Worn/broken oil control rings	X	
Scored liner and/or piston	X	
Excessive engine installation angle	X	
Crankcase overfilled	X	
Oil in air tanks (air compressor malfunction)	X	
Plugged crankcase breather	X	
Oil level low		X
Improper engine oil viscosity (fuel in the oil)		X
Faulty oil pressure regulator valve		X
Worn crankshaft bearings		X
Worn camshaft or connecting rod bearings		X
Missing cup plugs in rocker arm shafts		X
Faulty oil pressure relief valve		X
Air leaks in oil pump (suction side)		X
Worn or damaged oil pump		X
Faulty oil pressure gage		X
Faulty electrical components (for gage)		X
Plugged oil orifice		X
Obstructed oil line		X

ABNORMAL COOLANT TEMPERATURES

Probable Causes:

Restricted cooling system passages
 Restricted radiator core passages
 Slipping fan drive belts
 Faulty temperature-controlled fan
 Obstruction in front of radiator or intercooler
 Low coolant level
 Damaged hoses
 Faulty thermostats
 Faulty water pump
 Faulty radiator pressure cap
 Air in coolant
 Thermostats not fully closed
 Leakage around thermostat seals
 Faulty temperature-controlled fan

Above Normal	
Below Normal	
X	
X	
X	
X	
X	
X	
X	
X	
X	
X	
	X
	X
	X

ENGINE STORAGE

Preparing Engine for Storage

When an engine is to be stored or removed from operation for a period of time, special precautions should be taken to protect the interior and exterior of the engine, transmission and other parts from rust accumulation and corrosion. The parts requiring attention and the recommended preparations are given below.

It will be necessary to remove all rust or corrosion completely from any exposed part before applying rust preventive compound. Therefore, it is recommended that the engine be processed for storage as soon as possible after removal from operation.

The engine should be stored in a building that is dry and can be heated during the winter months. Moisture absorbing chemicals are available commercially for use when excessive dampness prevails in the storage area.

Temporary Storage (30 Days or Less)

To protect an engine for a temporary period of time, proceed as follows:

1. Drain the engine crankcase.
2. Fill the crankcase to the proper level with the recommended viscosity and grade of oil.
3. Fill the fuel tank with the recommended grade of fuel oil. Operate the engine for two minutes at 1200 rpm and no load. **Do not drain the fuel system or the crankcase after this run.**
4. Check the air cleaner and service it, if necessary.

5. If freezing weather is expected during the storage period, check the antifreeze/coolant for required freeze and inhibitor protection. Add antifreeze solution to the cooling system in accordance with the manufacturer's recommendations.

NOTE:

If an antifreeze solution is not required during storage, flush the cooling system with a good soluble oil (3% - 5% by volume) rust inhibitor to prevent rusting of the outside diameter of the cylinder liners.

6. Clean the exterior of the engine (except electrical components) with fuel oil and dry with compressed air.



CAUTION:

To avoid injury from flying debris when using compressed air, wear adequate eye protection (face shield or safety goggles) and do not exceed 40 psi (276 kPa) air pressure.

7. Seal all engine openings. The material used must be waterproof, vaporproof and possess sufficient physical strength to resist puncture and damage from the expansion of entrapped air.

An engine prepared in this manner can be returned to service in a short time by removing the seals at the engine openings and by checking the engine coolant, fuel oil, lubricating oil and transmission oil levels.

Extended Storage (More than 30 Days)

To prepare an engine for extended storage (more than 30 days), follow this procedure:

1. Drain the cooling system and flush with clean, soft water. Refill with clean, soft water and add a rust inhibitor to the cooling system.
2. Circulate the coolant by operating the engine until normal operating temperature is reached.
3. Stop the engine.
4. Drain the engine crankcase, then reinstall and tighten the 3/4"-14 square, magnetic oil drain plug to 45-50 N•m (33-37 lb-ft) torque. Install new lubricating oil filters.
5. Fill the crankcase to the proper level with Tectyl® 930A preservative lubricating oil or an equivalent 30-weight preservative lubricating oil meeting Mil-L-21260C, Grade 2 specification.
6. Drain the fuel tank. Refill with enough clean No. 1 diesel fuel or pure kerosene to permit the engine to operate for about ten minutes. If draining the fuel tank is not convenient, use a separate, portable supply of recommended fuel.

NOTE:

If engines are stored where condensation of water in the fuel tank may be a problem, additives containing Methyl Carbitol or Butyl Cellusolve may be added to the fuel. Follow manufacturer's instructions for treatment. Where biological contamination of fuel may be a problem, add a biocide such as Biobor® JF (or equivalent) to the fuel. When using a biocide, follow the manufacturer's concentration recommendations, and observe all cautions and warnings.

7. Drain the fuel system and remove the fuel filters. Dispose of used filters in an environmentally responsible manner, according to state and/or federal (EPA) recommendations. Fill new filters with No. 1 diesel fuel or pure kerosene, and reinstall on the engine.
8. Operate the engine for five minutes to circulate the clean fuel oil throughout the engine. Be sure the engine fuel system is full. Disconnect the fuel return line and the inlet line at the primary filter and securely plug both to retain the fuel in the engine.
9. Service the air cleaner.
10. **Transmission**—Follow the manufacturer's recommendations for prolonged storage.

11. **Power Take-Off**— (If equipped)— Follow the manufacturer's recommendations for prolonged storage.
12. **Turbocharger**—Since turbocharger bearings are pressure lubricated through the external oil line leading from the oil filter adapter while the engine is operating, no further attention is required. However, the turbocharger air inlet and turbine outlet connections should be sealed off with moisture-resistant tape.

NOTICE:

Failure to properly seal off turbocharger air inlet and exhaust outlet openings before engine storage may permit air drafts to circulate through the turbocharger and rotate the turbine/compressor shaft without an adequate flow of lubricating oil to the center housing bearings. This can result in severe bearing damage.

13. Apply a non-friction rust preventive compound to all exposed engine parts. If convenient, apply the rust preventive compound to the engine flywheel. If not, disengage the clutch mechanism to prevent the clutch disc from sticking to the flywheel.

NOTE:

Do not apply oil, grease or any wax base compound to the flywheel. The cast iron will absorb these substances, which can "sweat" out during operation and cause the clutch to slip.

14. Drain the engine cooling system.

15. Drain the preservative oil from the engine crankcase. Reinstall and tighten the 3/4"-14 square, magnetic drain plug to 45-50 N•m (33-37 lb-ft) torque.

16. Remove and clean the battery and battery cables with a baking soda-water solution and rinse with fresh water. Do not allow the soda solution to enter the battery. Add distilled water to the electrolyte (if necessary) and fully charge the battery. Store the battery in a cool (never below 0°C or 32°F) dry place. Keep the battery fully charged and check the level and specific gravity of the electrolyte regularly.

17. Insert heavy paper strips between the pulleys and drive belts to prevent sticking.

18. Seal all engine openings including the exhaust outlet, with moisture-resistant tape. Use cardboard, plywood or metal covers where practical.

19. Clean and dry the exterior painted surfaces of the engine and spray with a suitable liquid automobile body wax, a synthetic resin varnish, or a rust preventive compound.

20. Protect the engine with a good weather-resistant tarpaulin and store it under cover, preferably in a dry building which can be heated during the winter months.

Outdoor storage of engine is not recommended. If units must be kept out-of-doors, follow the preparation and storage instructions already given. Protect units with quality, weather-resistant tarpaulins (or other suitable covers) arranged to provide for air circulation.

NOTICE:

Do not use plastic sheeting for outdoor storage. Plastic is fine for indoor storage. When used outdoors, however, enough moisture can condense on the inside of the plastic to rust ferrous metal surfaces and pit aluminum surfaces. If a unit is stored outside for any extended period of time, severe corrosion damage can result.

The stored engine should be inspected periodically. If there are any indications of rust or corrosion, corrective steps must be taken to prevent damage to the engine parts. Perform a complete inspection at the end of one year and apply additional treatment as required.

Procedure for Restoring to Service an Engine that Has Been in Extended Storage

1. Remove the covers and tape from all of the openings of the engine, fuel tank and electrical equipment. Do not overlook the exhaust outlet.
2. Remove the plugs from the inlet and outlet fuel lines and reconnect the lines to their proper positions.
3. Wash the exterior of the engine with fuel oil to remove the rust preventive.
Do not wash electrical components.

4. Remove the rust preventive from the flywheel. Flush any soluble oil rust inhibitor if used in the cooling system (see Note, page 69).
5. Remove the paper strips from between the pulleys and drive belts.
6. Fill the crankcase to the proper level with the required grade of lubricating oil. Use a pressure lubricator to insure all bearings and rocker shafts are lubricated.
7. Fill the fuel tank with the required fuel.
8. Close all drain cocks and fill the engine cooling system with clean, soft water and required inhibitors. If the engine is to be exposed to freezing temperatures, install genuine Detroit Diesel **Power Cool**® antifreeze or an equivalent ethylene glycol-base or propylene glycol-base antifreeze solution which provides required freeze, boilover, and inhibitor protection. Refer to section **How to Select Coolant**.
9. Install and connect the battery. Make sure the average specific gravity of the battery is 1.260 or higher. Charge the battery if necessary.
10. Service the air cleaner, if required.
11. **Transmission**—Follow the manufacturer's recommendations covering the return of the transmission to service.

12. **Power Take-Off** (If equipped) — Follow the manufacturer's recommendations covering the return of the power take-off to service.
13. **Turbocharger**—Remove the covers from the turbocharger air inlet and turbine outlet connections. Reconnect piping as required. Prelube the turbocharger. Refer to the lubricating procedure outlined in **Preparations for Starting the Engine the First Time** (page 3).
14. After all preparations are completed, start the engine. The small amount of rust preventive compound which remains in the fuel system will cause smoky exhaust for a few minutes.

NOTE:

Before subjecting the engine to a load or high speed, allow it to reach normal operating temperature. Then, monitor the DDEC Diagnostic Data Link for trouble codes.

SERVICE PUBLICATIONS

The service manual covering Detroit Diesel Series 60 engines is listed in Table 18. Also listed are reference works which may be of interest to the owner/operator.

To purchase a copy of any of these publications, contact an authorized Detroit Diesel distributor in the U.S. or Canada. Check the Yellow Pages under "Engines, Diesel" or refer to the Distributor and Dealer Directory listed below for the distributor or service outlet nearest you.

Description	Form No.
Series 60 Engine Service Manual	6SE483
DDEC III/IV Single ECM Troubleshooting Guide	6SE497
U.S. and Canada Distributor/Dealer Directory	6SE280
International Distributor/Dealer Directory	6SE281
Lube Oil, Fuel, Filter Requirements	7SE270
Coolant Requirements for Engine Cooling Systems	7SE298
Technician's Guide — Used Lubricating Oil Analysis.....	7SE398

Table 18. Service Publications

DETROIT DIESEL CUSTOMER ASSISTANCE U.S. AND CANADA 1-800-445-1980

If you require road service for any reason in the U.S. or Canada, you may call the 1-800-445-1980 customer assistance phone number. An operator will assist you in determining what type of service is required. Not all problems are engine related and not all problems are covered by engine or vehicle warranties. *YOU MAY BE RESPONSIBLE FOR REPAIR EXPENSES.*

Before calling Customer Assistance, please do the following:

- Check coolant level
- Check fuel level
- Check DDEC fuses
- Check for fuel leaks

- Make sure manual fuel shutoff valve (if installed) on the fuel filter adapter, fuel processor body, or fuel supply line is open.
- Check oil level on the dipstick
- Check diagnostic codes per page 14 (DDEC III/IV).

If you call, have the following information available:

- Engine serial number
- Truck, bus, or equipment make and model
- Odometer mileage
- Truck, bus, or equipment owner/company name

CUSTOMER ASSISTANCE

The satisfaction and goodwill of the owners of Detroit Diesel engines are of primary concern to Detroit Diesel Corporation and its distributor/dealer

organizations.

As the owner of a Detroit Diesel product you have a complete network of over 2,000 Detroit Diesel service outlets in the U.S. and Canada, plus many outlets worldwide that are prepared to meet your parts and service needs:



EASTERN REGION

Long Branch, New Jersey
187 Monmouth Park Highway
West Long Branch, NJ 07764
Phone: (732) 222-1888
Fax: (732) 222-3411

SOUTHEASTERN REGION

Jacksonville, Florida
5111 Bowden Road
Jacksonville, FL 32216
Phone: (904) 448-8833
Fax: (904) 448-2444

CENTRAL REGION

Detroit, Michigan
13400 Outer Drive, West
Detroit, MI 48239-4001
Phone: (313) 592-5990
Fax: (734) 762-1032

SOUTHWESTERN REGION

Dallas, Texas
2711 LBJ Freeway
Suite 1036
Dallas, TX 75234
Phone: (972) 247-4313
Fax: (972) 247-4316

WESTERN REGION

Downey, California
10645 Studebaker Road
Downey, CA 90241
Phone: (562) 929-7016
Fax: (562) 864-0502

CANADIAN REGION

London, Ontario
Detroit Diesel of Canada Ltd.
150 Dufferin Ave., Suite 701
London, ON N6A 5N6
Phone: (519) 661-0149
Fax: (519) 661-0171

LATIN AMERICAN REGION

Miami, Florida
2277 N.W. 14th Street
Miami, FL 33125-0068
Phone: (305) 637-1555
Fax: (305) 637-1580

ASIAN REGION

Singapore
No. 1 Benoi Place
Singapore 629923
Phone: (65) 865-1912
Fax: (65) 865-1618

PACIFIC REGION

Australia
12 Dalgetty Road
Beaumaris, Victoria 3193
Australia
Phone: (61) 3-9589-0484
Fax: (61) 3-9589-6858

EUROPE, MIDDLE EAST, AFRICA (EMA) REGION

The Netherlands
Ridderpoort 9
P.O. Box 4161
2980 GD Ridderkerk
The Netherlands
Phone: (31) 1804-63388
Fax: (31) 1804-62062

MEXICO

Detroit Diesel Allison de Mexico
Av. Santa Rosa 58
Col. Ampliacion Norte
San Juan Ixtacala, Tlaxepantla
C.P. 54160, Edo de Mexico
Phone: (525) 333-1802
Fax: (525) 333-1870

- Service by trained personnel.
- Sales teams to help determine your specific power requirements.
- In many areas, emergency service 24 hours a day.
- Complete parts support including **reliabilt** components.
- Product information and literature.

We recognize however, that despite the best intentions of everyone concerned, misunderstandings may occur. Normally, any situation that arises in connection with the sale, operation or service of your product will be handled by the authorized service outlet in your area (in the U.S. and Canada check the Yellow Pages for the Detroit Diesel service outlet nearest you).

To further assure your complete satisfaction, we have developed the following procedure to be followed in the event you have a problem that has not been handled satisfactorily.

Step One

Discuss your problem with a member of management from the authorized service outlet. Frequently, complaints are the result of a breakdown in communication and can quickly be resolved by a member of management. If you have already discussed the problem with the Sales or Service Manager, contact the General Manager. If your complaint originates with a dealer, explain the matter to a management member of the distributorship with whom the dealer has his service agreement.

Step Two

When it appears that your problem cannot readily be resolved at the distributor level without additional assistance, con-

tact the Detroit Diesel Regional Product Support or Operations Manager responsible for your local distributor. You will be assisted by a member of the Manager's staff, depending upon the nature of your problem.

Prior to this contact, have the following information available:

- Engine serial number* _____
- Name and location of authorized service outlet.
- Type and make of equipment.
- Engine model and serial number.
- Engine delivery date and accumulated miles or hours of operation.
- Nature of problem.
- Chronological summary of engine's history.

***Important:** Your engine serial number should be written on the line provided. It will identify your model and all service parts, plus provide warranty and extended coverage information.

Step Three

If you are still not satisfied, present the entire matter in writing or by phone to:

Vice President, Customer Assurance

Detroit Diesel Corporation
13400 Outer Drive, West
Detroit, Michigan 48239-4001
Phone: (313) 592-7357
FAX: (313) 592-7888

When contacting the regional or home office, please keep in mind that ultimately your problem will likely be resolved at the distributorship or dealership, utilizing their facilities, equipment, and personnel. Therefore, it is suggested that you follow the above steps in sequence when experiencing a problem.

LIMITED WARRANTY ON NEW DETROIT DIESEL SERIES 60 ENGINES USED IN ON-HIGHWAY VEHICLE APPLICATIONS

TERMS OF COVERAGE

Uses

This warranty applies to the first retail purchaser and subsequent owners during the WARRANTY PERIOD of new Detroit Diesel Series 60® Engines (referred to as Engine) manufactured by Detroit Diesel Corporation and/or supplied by Detroit Diesel Corporation, Detroit Diesel of Canada Limited or Detroit Diesel Overseas Distribution Corporation (all which are collectively referred to as DDC) which are used in on-highway vehicle applications.

Defects

This warranty covers Engine REPAIRS to correct any malfunction occurring during the WARRANTY PERIOD resulting from defects in material or workmanship.

Repairs

To obtain warranty repairs, you must request the needed repairs within the WARRANTY PERIOD from an authorized DDC service outlet. Only new genuine parts or remanufactured parts or components supplied or approved by DDC will be used. DDC may, at its discretion, replace rather than repair components. A reasonable time must be allowed to perform the warranty repair after taking the engine to the authorized service outlet. The owner is responsible for the percentage of repair costs shown in the warranty period chart. Repairs will be performed during normal business hours.

Warranty Period

The WARRANTY PERIOD begins on the date the engine is delivered to the first retail purchaser or put in use prior to sale at retail, whichever date occurs first, and ends at the time or mileage/kilometer limits shown in the WARRANTY PERIOD chart.

WARRANTY PERIOD				
Item	Warranty Limitations (Whichever Occurs First)		Repair Charges to be Paid by Owner	
	MONTHS	MILES/ KILOMETERS	PARTS	LABOR
Engine#	0-24	Unlimited	No Charge	No Charge
Accessories	0-24	0-50,000 miles 0-80,000 km	No Charge No Charge	No Charge No Charge
<i>Upon expiration of the 24 month warranty coverage, but within 500,000mi/ 800,000 km of use, the warranty continues to apply as follows:</i>				
Major Components†	25-60	0-500,000 miles 0-800,000 km	No Charge	100% of service outlet's normal charge

Includes Jacobs Vehicle Systems Braking Devices and 50DN or T1 Alternators, if Installed.

† Cylinder Block/Head, Crankshaft, Camshaft, Main Bearing Bolts, Flywheel Housing, Connecting Rod Assemblies, Oil Cooler Housing, Water Pump Housing, and Air Inlet Housing, and TF550 Air Compressors if so equipped.

Warranty Period Chart – On-Highway Vehicle Applications

Like Replacement Engine

Engine(s) supplied by DDC as a replacement for an engine still under warranty will assume the identity of the engine being replaced and be entitled to the remaining warranty coverage.

Service Supplies

The cost of service supplies such as coolant, oil and filters which are not reusable due to needed warranty repairs is covered by this warranty.

Engine Removal and Reinstallation

Labor costs for Engine removal and reinstallation, when necessary to make a warranty repair, are covered by this warranty.

THIS WARRANTY DOES NOT COVER:**Repairs Due to Accidents, Misuse, Storage Damage, Negligence or Certain Modifications**

Repairs due to an accident, misuse, misapplication, storage damage, negligence or modification exceeding DDC specifications are not covered by this warranty.

Braking Devices

DDC is not responsible for the repair of non-Jacobs Vehicle Systems mechanical braking devices installed on the engine. Such devices are warranted by the brake manufacturer.

Fuel Injectors After 100,000 Miles/160,000 Kilometers

The repair or replacement of fuel injectors after 100,000 miles/160,000 kilometers of operation is not covered by this warranty.

Maintenance

DDC is not responsible for the cost of maintenance or repairs due to lack of performance of required maintenance services as recommended by DDC, or the failure to use fuel, oil, lubricants and coolant meeting DDC-recommended specifications. Performance of the required maintenance and use of proper fuel, oil, lubricants and coolant are the responsibility of the owner. Refer to the "Lubrication and Preventive Maintenance Intervals" section of this Operator's Guide for details.

Incidental or Consequential Damages

Detroit Diesel Corporation is not responsible for incidental or consequential costs or expenses which the owner may incur as a result of a malfunction or failure covered by this warranty, such as communication expenses, meals, lodging, overtime, towing, loss of use of the engine or vehicle ("downtime"), loss of time, inconveniences, cargo loss or damage, and other similar costs and expenses.

Other Limitations

The performance of REPAIRS is the exclusive Owner's remedy under this warranty. Detroit Diesel Corporation does not authorize any person to assume or create for it any other obligation or liability in connection with the engine or the accessories.

THIS WARRANTY AND THE EMISSIONS CONTROL WARRANTY ARE THE ONLY WARRANTIES APPLICABLE TO THE ENGINE AS USED IN ON-HIGHWAY VEHICLE APPLICATIONS. DETROIT DIESEL CORPORATION MAKES NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DETROIT DIESEL CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS DESCRIBED ABOVE.

Some states do not allow the limitation of how long this warranty may last or the limitation or exclusion of incidental or consequential damages, so the above may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

LIMITED WARRANTY ON NEW DETROIT DIESEL SERIES 60 ENGINES POWERING URBAN BUS, MOTOR COACH OR MOTOR HOME APPLICATIONS

TERMS OF COVERAGE:

Uses

This warranty applies to the first retail purchaser and subsequent owners during the WARRANTY PERIOD of new Detroit Diesel Series 60® Engines (referred to as Engine) manufactured by Detroit Diesel Corporation and/or supplied by Detroit Diesel Corporation, Detroit Diesel of Canada Limited or Detroit Diesel Overseas Distribution Corporation (all which are collectively referred to as DDC) powering urban bus, motor coach or motor home applications.

Defects

This warranty covers Engine REPAIRS to correct any malfunction occurring during the WARRANTY PERIOD resulting from defects in material or workmanship.

Repairs

To obtain warranty repairs, you must request the needed repairs within the WARRANTY PERIOD from an authorized DDC service outlet. Only new genuine parts or remanufactured parts or components supplied or approved by DDC will be used. DDC may, at its discretion, replace rather than repair components. A reasonable time must be allowed to perform the warranty repair after taking the engine to the authorized service outlet. Repairs will be performed during normal business hours.

Warranty Period

The WARRANTY PERIOD begins on the date the Engine is delivered to the first retail purchaser or put in use prior to sale at retail, whichever date occurs first, and ends at the time or mileage/kilometer limits shown below:

WARRANTY PERIOD				
ITEM	Warranty limitations (Whichever Occurs First)		Repair Charge To Be Paid by the Owner	
	MONTHS	MILES/KILOMETERS	PARTS	LABOR
Engine*	0-24	Unlimited	No Charge	No Charge
	<i>Upon expiration of the 24 month warranty coverage, but within 500,000 mi/ 800,000 km of use, the warranty continues to apply as follows:</i>			
†Major Components	25-60	0-500,000 mi 0-800,000 km	No Charge	100% of service outlet's normal charge

†Cylinder Block/Head, Crankshaft, Camshaft, Main Bearing Bolts, Flywheel Housing, Connecting Rod Assemblies, Oil Cooler Housing, Water Pump Housing and Air Inlet Housing.

•Includes Jacobs Vehicle Systems braking devices, 50DN or T1 alternators if so equipped.

Warranty Period Chart – Urban Bus, Motor Coach, and Motor Home Applications

Service Supplies

The cost of service supplies such as coolant, oil and filters which are not reusable due to warranted repairs is covered by this warranty.

Like Replacement Engine

Engine(s) supplied by DDC as a replacement for an Engine still under warranty will assume the identity of the Engine being replaced and be entitled to the remaining warranty coverage.

Engine Removal and Reinstallation

Reasonable labor costs for engine removal and reinstallation, when necessary to make a warranty repair, are covered by this warranty.

THIS WARRANTY DOES NOT COVER:**Repairs Due to Accidents, Misuse, Alteration, Storage Damage, Negligence or Certain Modifications**

Repairs due to an accident, misuse, alteration, misapplication, storage damage, negligence or modification exceeding DDC specifications are not covered by this warranty.

Braking Devices

DDC is not responsible for the repair of non-Jacobs Vehicle Systems mechanical braking devices installed on the Engine. Such devices are warranted by the brake manufacturer.

Fuel Injectors and Starting Motors After 100,000 Miles/ 160 000 Kilometers

The repair or replacement of fuel injectors and starting motors after 100,000 miles/160 000 kilometers of operation is not covered by this warranty.

Maintenance

DDC is not responsible for the cost of maintenance or repairs due to lack of performance of required maintenance services or the failure to use fuel, oil, lubricants and coolant meeting DDC-recommended specifications. Performance of required maintenance and use of proper fuel, oil, lubricants and coolant are the responsibility of the owner. See the Engine Operator's Guide for full details.

Incidental or Consequential Damages

DDC is not responsible for incidental or consequential costs or expenses which the owner may incur as a result of a malfunction or failure covered by this warranty, such as communication expenses, meals, lodging, overtime, towing, loss of use of the Engine or vehicle ("downtime"), loss of time, inconvenience, cargo loss or damage, and other similar costs and expenses.

Other Limitations

The performance of REPAIRS is the exclusive Owner's remedy under this warranty. DDC does not authorize any person to assume or create for it any other obligation or liability in connection with the Engine.

THIS LIMITED WARRANTY AND THE EMISSIONS CONTROL WARRANTY ARE THE ONLY WARRANTIES APPLICABLE TO THESE ENGINES POWERING URBAN BUS, MOTOR COACH OR MOTOR HOME APPLICATIONS. DETROIT DIESEL CORPORATION MAKES NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DETROIT DIESEL CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS DESCRIBED ABOVE.

Some states do not allow the limitation of how long this warranty may last or the limitation or exclusion of incidental or consequential damages, so the above may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

**LIMITED WARRANTY ON
NEW DETROIT DIESEL
SERIES 60 ENGINES AND
ENGINE ACCESSORIES
USED IN CONSTRUCTION/
INDUSTRIAL
APPLICATIONS**

TERMS OF COVERAGE:

Uses

This warranty applies to the first retail purchaser and subsequent owners during the WARRANTY PERIOD of new Detroit Diesel Series 60® Engines (referred to as Engine) manufactured by Detroit Diesel Corporation and/or supplied by Detroit Diesel Corporation, Detroit Diesel of Canada Limited or Detroit Diesel Overseas Distribution Corporation (all which are collectively referred to as DDC) which are used in construction/industrial applications.

Defects

This warranty covers Engine REPAIRS to correct any malfunction occurring during the WARRANTY PERIOD resulting from defects in material or workmanship.

Repairs

To obtain warranty repairs, you must request the needed repairs within the WARRANTY PERIOD from an authorized DDC service outlet. Only new genuine parts or remanufactured parts or components supplied or approved by DDC will be used. DDC may, at its discretion, replace rather than repair components. A reasonable time must be allowed to perform the warranty repair after taking the engine to the authorized service outlet. Repairs will be performed during normal business hours.

The owner is responsible for the percentage of repair costs shown in the WARRANTY PERIOD CHART.

ITEM	WARRANTY PERIOD			
	Warranty limitations (Whichever Occurs First)		Adjustment Charge to be Paid by the Owner	
	MONTHS	ENGINE HOURS	PARTS	LABOR
Engine	0-12	No Limit	No Charge	No Charge
Accessories	0-12	0-2,000	No Charge	No Charge
	<i>Upon expiration of the twelve (12) month warranty coverage, but within 12,000 hours of use, the warranty continues to apply as follows:</i>			
Block, Crankshaft and Connecting Rods	13-36	0-12,000	No Charge	No Charge

Warranty Period Chart – Construction/Industrial Applications

Warranty Period

The WARRANTY PERIOD begins on the date the Engine is delivered to the first retail purchaser or put in use prior to sale at retail, whichever date occurs first, and ends at the time or hour limits shown in the WARRANTY PERIOD chart on the preceding page.

Service Supplies

The cost of service supplies such as coolant, oil and filters which are not reusable due to warranted repairs is covered by this warranty.

Engine Removal and Reinstallation - Construction/Industrial Applications

Reasonable labor costs for engine removal and reinstallation, when necessary to make a warranty repair, are covered by this warranty during the first twelve (12) months of service.

Mechanic's Travel Expenses

DDC will pay reasonable travel expenses for the repairing mechanic to travel to and from the repair site.

Like Replacement Engine

Engine(s) supplied by DDC as a replacement for an Engine still under warranty will assume the identity of the Engine being replaced and be entitled to the remaining warranty coverage.

THIS WARRANTY DOES NOT COVER:**Repairs Due to Accidents, Misuse, Storage Damage, Negligence or Certain Modifications**

Repairs due to an accident, misuse, misapplication, storage damage, negligence or modification exceeding DDC specifications are not covered by this warranty.

Engine Removal and Reinstallation-Agricultural Machinery and Stand-by Pump Applications

Labor and material costs for engine removal and reinstallation, when necessary to make a warranty repair, are not covered by this warranty when the engine is in an agricultural machinery or stand-by pump application.

Non-DDC Supplied/Manufactured Components

DDC is not responsible for repair of components and/or assemblies which are manufactured or supplied by another manufacturer, such as non-DDC power take-offs and intake and exhaust systems. Such items are covered by the equipment manufacturer.

Maintenance

DDC is not responsible for the cost of maintenance or repairs due to lack of performance of required maintenance services as recommended by DDC, or the failure to use fuel, oil, lubricants and coolant meeting DDC-recommended specifications. Performance of the required maintenance and use of proper fuel, oil, lubricants and coolant are the responsibility of the owner. Refer to the "Lubrication and Preventive Maintenance Intervals" Section of this Operator's Guide for details.

Incidental or Consequential Damages

DDC is not responsible for incidental or consequential costs or expenses which the owner may incur as a result of a malfunction or failure covered by this warranty, such as communication expenses, meals, lodging, overtime, towing, and any associated loss of use of the Engine or equipment ("downtime"), loss of time, inconvenience, cargo loss or damage, and other similar costs and expenses.

Other Limitations

The performance of REPAIRS is the exclusive Owner's remedy under this warranty. DDC does not authorize any person to assume or create for it any other obligation or liability in connection with the Engine or the Accessories.

THIS WARRANTY AND THE EMISSIONS CONTROL WARRANTY ARE THE ONLY WARRANTIES APPLICABLE TO THE ENGINE AND ACCESSORIES AS USED IN CONSTRUCTION/INDUSTRIAL, AGRICULTURAL MACHINERY AND STAND-BY PUMP APPLICATIONS. DETROIT DIESEL CORPORATION MAKES NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DETROIT DIESEL CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS DESCRIBED ABOVE.

Some states do not allow the limitation of how long this warranty may last or the limitation or exclusion of incidental or consequential damages, so the above may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

LIMITED WARRANTY ON NEW DETROIT DIESEL SERIES 60 ENGINES USED IN FIRE TRUCK OR CRASH RESCUE VEHICLE APPLICATIONS

TERMS OF COVERAGE

Uses

This warranty applies to the first retail purchaser and subsequent owners during the WARRANTY PERIOD of new Detroit Diesel Series 60® Engines (referred to as Engine) manufactured by Detroit Diesel Corporation and/or supplied by Detroit Diesel Corporation, Detroit Diesel of Canada Limited or Detroit Diesel Overseas Distribution Corporation (all which are collectively referred to as DDC) which are used in fire truck or crash rescue vehicle applications.

Defects

This warranty covers Engine REPAIRS to correct any malfunction occurring during the WARRANTY PERIOD resulting from defects in material or workmanship.

Repairs

To obtain warranty repairs, you must request the needed repairs within the WARRANTY PERIOD from an authorized DDC service outlet. Only new genuine parts or remanufactured parts or components supplied or approved by DDC will be used. DDC may, at its discretion, replace rather than repair components. A reasonable time must be allowed to perform the warranty repair after taking the engine to the authorized service outlet. Repairs will be performed during normal business hours.

Warranty Period

The WARRANTY PERIOD begins on the date the engine is delivered to the first retail purchaser or put in use prior to sale at retail, whichever date occurs first, and ends at the time or mileage/kilometer limits shown in the WARRANTY PERIOD chart.

Like Replacement Engine

Engine(s) supplied by DDC as a replacement for an engine still under warranty will assume the identity of the engine being replaced and be entitled to the remaining warranty coverage.

WARRANTY PERIOD				
Item	Warranty Limitations (Whichever Occurs First)		Repair Charges to be Paid by Owner	
	MONTHS	MILES/ KILOMETERS	PARTS	LABOR
Engine	0-60	0-50,000 miles 0-80,000 km	No Charge	No Charge
Accessories	0-24	0-50,000 miles 0-80,000 km	No Charge	No Charge

Warranty Period Chart – Fire Truck or Crash/Rescue Vehicle Applications

Service Supplies

The cost of service supplies such as coolant, oil and filters which are not reusable due to needed warranty repairs is covered by this warranty.

Engine Removal and Reinstallation

Reasonable labor costs for Engine removal and reinstallation, when necessary to make a warranty repair, are covered by this warranty.

THIS WARRANTY DOES NOT COVER:

Repairs Due to Accidents, Misuse, Storage Damage, Negligence or Certain Modifications

Repairs due to an accident, misuse, misapplication, storage damage, negligence or modification exceeding DDC specifications are not covered by this warranty.

Maintenance

DDC is not responsible for the cost of maintenance or repairs due to lack of performance of required maintenance services as recommended by DDC, or the failure to use fuel, oil, lubricants and coolant meeting DDC-recommended specifications. Performance of the required maintenance and use of proper fuel, oil, lubricants and coolant are the responsibility of the owner. Refer to the "Lubrication and Preventive Maintenance Intervals" section of this Operator's Guide for details.

Incidental or Consequential Damages

Detroit Diesel Corporation is not responsible for incidental or consequential costs or expenses which the owner may incur as a result of a malfunction or failure covered by this warranty, such as communication expenses, meals, lodging, overtime, towing, loss of use of the engine or vehicle ("downtime"), loss of time, inconveniences, cargo loss or damage, and other similar costs and expenses.

Other Limitations

The performance of REPAIRS is the exclusive Owner's remedy under this warranty. Detroit Diesel Corporation does not authorize any person to assume or create for it any other obligation or liability in connection with the engine or the accessories.

THIS WARRANTY AND THE EMISSIONS CONTROL WARRANTY ARE THE ONLY WARRANTIES APPLICABLE TO THE ENGINE AS USED IN FIRE TRUCK OR CRASH RESCUE VEHICLE APPLICATIONS. DETROIT DIESEL CORPORATION MAKES NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DETROIT DIESEL CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS DESCRIBED ABOVE.

Some states do not allow the limitation of how long this warranty may last for the limitation or exclusion of incidental or consequential damages, so the above may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

LIMITED WARRANTY ON NEW DETROIT DIESEL SERIES 60 ENGINES USED IN AGRICULTURAL MACHINERY

TERMS OF COVERAGE

Uses

This warranty applies to the first retail purchaser and subsequent owners during the WARRANTY PERIOD of new Detroit Diesel Series 60® Engines (referred to as Engine) manufactured by Detroit Diesel Corporation and/or supplied by Detroit Diesel Corporation, Detroit Diesel of Canada Limited or Detroit Diesel Overseas Distribution Corporation (all which are collectively referred to as DDC) which are used in agricultural machinery.

Defects

This warranty covers Engine REPAIRS to correct any malfunction occurring during the WARRANTY PERIOD resulting from defects in material or workmanship.

Repairs

To obtain warranty repairs, you must request the needed repairs within the WARRANTY PERIOD from an authorized DDC service outlet. Only new genuine parts or remanufactured parts or components supplied or approved by DDC will be used. DDC may, at its discretion, replace rather than repair components. A reasonable time must be allowed to perform the warranty repair after taking the engine to the authorized service outlet. Repairs will be performed during normal business hours.

Warranty Period

The WARRANTY PERIOD begins on the date the engine is delivered to the first retail purchaser or put in use prior to sale at retail, whichever date occurs first, and ends at the time or limits shown in the WARRANTY PERIOD chart.

Like Replacement Engine

Engine(s) supplied by DDC as a replacement for an engine still under warranty will assume the identity of the engine being replaced and be entitled to the remaining warranty coverage.

Service Supplies

The cost of service supplies such as coolant, oil and filters which are not reusable due to needed warranty repairs is covered by this warranty.

THIS WARRANTY DOES NOT COVER:

Repairs Due to Accidents, Misuse, Storage Damage, Negligence or Certain Modifications

Repairs due to an accident, misuse, misapplication, storage damage, negligence or modification exceeding DDC specifications are not covered by this warranty.

Engine Removal and Reinstallation

Labor costs for Engine removal and reinstallation, when necessary to make a warranty repair, are not covered by this warranty.

Non-DDC Supplied/Manufactured Components

DDC is not responsible for repair of components and/or assemblies which are manufactured or supplied by another manufacturer, such as intake and exhaust systems. Such items may be covered by warranties issued by the manufacturer or supplier.

Maintenance

DDC is not responsible for the cost of maintenance or repairs due to lack of performance of required maintenance services as recommended by DDC, or the failure to use fuel, oil, lubricants and coolant meeting DDC-recommended specifications. Performance of the required maintenance and use of proper fuel, oil, lubricants and coolant are the responsibility of the owner. Refer to the "Lubrication and Preventive Maintenance Intervals" section of this Operator's Guide for details.

WARRANTY PERIOD				
Item	Warranty Limitations (Whichever Occurs First)		Repair Charges to be Paid by Owner	
	MONTHS	ENGINE HOURS	PARTS	LABOR
Engine	Up to 36	Up to 2,500	No Charge	No Charge
Accessories	Up to 12	Up to 2,000	No Charge	No Charge

Warranty Period Chart – Agricultural Machinery

Incidental or Consequential Damages

This warranty does not cover any economic loss, including without limitation, communication expenses, meals, lodging, loss of use of the Engine or equipment, loss of time, inconvenience, cargo damage, overtime, towing or any other cost or expense resulting from a defect covered by this warranty.

Other Limitations

THIS WARRANTY IS THE ONLY WARRANTY APPLICABLE TO THE ENGINE AS USED IN AGRICULTURAL MACHINERY APPLICATIONS. DETROIT DIESEL CORPORATION MAKES NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DETROIT DIESEL CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS DESCRIBED ABOVE.

Some states do not allow the limitation of how long this warranty may last for the limitation or exclusion of incidental or consequential damages, so the above may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

LIMITED WARRANTY ON NEW DETROIT DIESEL SERIES 60 ENGINES USED IN PRIME POWER GENERATOR SETS

TERMS OF COVERAGE

Uses

This warranty applies to the first retail purchaser and subsequent owners during the WARRANTY PERIOD of new Detroit Diesel Series 60® Engines (referred to as Engine) manufactured by Detroit Diesel Corporation and/or supplied by Detroit Diesel Corporation, Detroit Diesel of Canada Limited or Detroit Diesel Overseas Distribution Corporation (all which are collectively referred to as DDC) which are used in prime power generators delivered in the U.S. or Canada.

Defects

This warranty covers Engine REPAIRS to correct any malfunction occurring during the WARRANTY PERIOD resulting from defects in material or workmanship.

Repairs

To obtain warranty repairs, you must request the needed repairs within the WARRANTY PERIOD from an authorized DDC service outlet. Only new genuine parts or remanufactured parts or components supplied or approved by DDC will be used. DDC may, at its discretion, replace rather than repair components. A reasonable time must be allowed to perform the warranty repair after taking the engine to the authorized service outlet. Repairs will be performed during normal business hours.

Warranty Period

The WARRANTY PERIOD begins on the date the engine is delivered to the first retail purchaser or put in use prior to sale at retail, whichever date occurs first, and ends at the time limits shown in the WARRANTY PERIOD chart.

Like Replacement Engine

Engine(s) supplied by DDC as a replacement for an engine still under warranty will assume the identity of the engine being replaced and be entitled to the remaining warranty coverage.

Service Supplies

The cost of service supplies such as coolant, oil and filters which are not reusable due to needed warranty repairs is covered by this warranty.

Mechanic's Travel Expenses

DDC will pay reasonable travel expenses for the repairing mechanic to travel to and from the repair site.

THIS WARRANTY DOES NOT COVER:**Repairs Due to Accidents, Misuse, Storage Damage, Negligence or Certain Modifications**

Repairs due to an accident, misuse, misapplication, storage damage, negligence or modification exceeding DDC specifications are not covered by this warranty.

Engine Removal and Reinstallation

Reasonable labor costs for Engine removal and reinstallation, when necessary to make a warranty repair, are covered by this warranty.

Non-DDC Supplied/Manufactured Components

DDC is not responsible for repair of components and/or assemblies such as intake and exhaust systems and fuel storage tanks which are manufactured or supplied by another manufacturer. Such items may be covered by the equipment manufacturer.

WARRANTY PERIOD				
Item	Warranty Limitations (Whichever Occurs First)		Repair Charges to Be Paid by Owner	
	MONTHS	ENGINE HOURS	PARTS	LABOR
Engine	0-12	Unlimited	No Charge	No Charge
<i>Upon expiration of the 12 month warranty coverage, but within 12,000 hours of use, the warranty continues to apply as follows:</i>				
Block, crankshaft, and connecting rods (assemblies)	13-36	0-12,000	No Charge	100% of service outlet's normal charge

Warranty Period Chart – Prime Power Generator Set

Maintenance

DDC is not responsible for the cost of maintenance or repairs due to lack of performance of required maintenance services as recommended by DDC, or the failure to use fuel, oil, lubricants, cooling air and ventilation meeting DDC-recommended specifications. Performance of the required maintenance and use of proper fuel, oil, lubricants, cooling air and ventilation are the responsibility of the owner. Refer to the "Lubrication and Preventive Maintenance Intervals" section of this Operator's Guide for details.

Incidental or Consequential Damages

This warranty does not cover any economic loss, including without limitation communication expenses, meals, lodging, loss of use of the Engine, loss of time, inconvenience, overtime, transportation of the Engine or any other cost or expense resulting from a defect covered by this warranty.

Other Limitations

THIS WARRANTY IS THE ONLY WARRANTY APPLICABLE TO THE ENGINE AS USED IN PRIME POWER GENERATORS. DETROIT DIESEL CORPORATION MAKES NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DETROIT DIESEL CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS DESCRIBED ABOVE.

Some states do not allow the limitation of how long this warranty may last for the limitation or exclusion of incidental or consequential damages, so the above may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

LIMITED WARRANTY ON NEW DETROIT DIESEL SERIES 60 ENGINES USED IN STAND-BY POWER GENERATOR SETS

TERMS OF COVERAGE

Uses

This warranty applies to the first retail purchaser and subsequent owners during the WARRANTY PERIOD of new Detroit Diesel Series 60® Engines (referred to as Engine) manufactured by Detroit Diesel Corporation and/or supplied by Detroit Diesel Corporation, Detroit Diesel of Canada Limited or Detroit Diesel Overseas Distribution Corporation (all which are collectively referred to as DDC) which are used in stand-by generators delivered in the U.S. or Canada.

Defects

This warranty covers Engine REPAIRS to correct any malfunction occurring during the WARRANTY PERIOD resulting from defects in material or workmanship.

Repairs

To obtain warranty repairs, you must request the needed repairs within the WARRANTY PERIOD from an authorized DDC service outlet. Only new genuine parts or remanufactured parts or components supplied or approved by DDC will be used. DDC may, at its discretion, replace rather than repair components. A reasonable time must be allowed to perform the warranty repair after taking the engine to the authorized service outlet. Repairs will be performed during normal business hours.

Warranty Period

The WARRANTY PERIOD begins on the date the engine is delivered to the first retail purchaser or put in use prior to sale at retail, whichever date occurs first, and ends at the time limits shown in the WARRANTY PERIOD chart.

Like Replacement Engine

Engine(s) supplied by DDC as a replacement for an engine still under warranty will assume the identity of the engine being replaced and be entitled to the remaining warranty coverage.

Service Supplies

The cost of service supplies such as coolant, oil and filters which are not reusable due to needed warranty repairs is covered by this warranty.

Mechanic's Travel Expenses

DDC will pay reasonable travel expenses for the repairing mechanic to travel to and from the repair site.

THIS WARRANTY DOES NOT COVER:

Repairs Due to Accidents, Misuse, Storage Damage, Negligence or Certain Modifications

Repairs due to an accident, misuse, misapplication, storage damage, negligence or modification exceeding DDC specifications are not covered by this warranty.

Engine Removal and Reinstallation

Reasonable labor costs for Engine removal and reinstallation, when necessary to make a warranty repair, are covered by this warranty.

Non-DDC Supplied/Manufactured Components

DDC is not responsible for repair of components and/or assemblies such as intake and exhaust systems and fuel storage tanks which are manufactured or supplied by another manufacturer. Such items may be covered by warranties issued by the manufacturer or supplier.

Maintenance

DDC is not responsible for the cost of maintenance or repairs due to lack of performance of required maintenance services as recommended by DDC, or the failure to use fuel, oil, lubricants and coolant meeting DDC-recommended specifications. Performance of the required maintenance and use of proper fuel, oil, lubricants and coolant are the responsibility of the owner. Refer to the "Lubrication and Preventive Maintenance Intervals" section of this Operator's Guide for details.

Incidental or Consequential Damages

This warranty does not cover any economic loss, including without limitation communication expenses, meals, lodging, loss of use of the Engine, loss of time, inconvenience, overtime, transportation of the Engine or any other cost or expense resulting from a defect covered by this warranty.

Other Limitations

THIS WARRANTY IS THE ONLY WARRANTY APPLICABLE TO THE ENGINE AS USED IN STAND-BY GENERATORS. DETROIT DIESEL CORPORATION MAKES NO OTHER WARRANTIES EXPRESS OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. DETROIT DIESEL CORPORATION SHALL NOT BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES AS DESCRIBED ABOVE.

Some states do not allow the limitation of how long this warranty may last for the limitation or exclusion of incidental or consequential damages, so the above may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which may vary from state to state.

WARRANTY PERIOD				
Item	Warranty Limitations (Whichever Occurs First)		Repair Charges to Be Paid by Owner	
			PARTS	LABOR
Engine	MONTHS Up to 24	ENGINE HOURS 0-800	No Charge	No Charge

Warranty Period Chart – Stand-by Generator Set

SPECIFICATIONS

FILTERS

Table 19. FUEL FILTER REQUIREMENTS — Series 60 Regular Service	
Filter Type	Detroit Diesel Part No.
Primary Spin—On	23518481
Primary Water/Separator, Spin—On†	23512317†
Secondary Spin—On	23518482
Fuel Pro 380/382 Primary Element	23521528
LUBRICATING OIL FILTER ELEMENT REQUIREMENT	
Filter Type	Detroit Diesel Part No.
Full Flow	23527033
Full Flow (High Capacity)	23524251
Full Flow #	23523701#

† Optional. May be used in place of, but not together with, primary filter.

For use with synthetic lubricating oil only.

Table 20. OIL PAN CAPACITY	
All Series 60 on-highway truck oil pans (front sump and rear sump) require the same amount of engine oil:	
26 quarts to the LOW mark	Without oil filters
32 quarts to the FULL mark	Without oil filters
TOTAL OIL CAPACITY OF THE ENGINE	
40 quarts to the FULL mark	With oil filters installed and filters and oil galleries charged.

POWER COOL ENGINE PRODUCTS

Table 21. Power Cool Fully Formulated IEG Coolant		
Coolant Type	Part Number	Description
Concentrated	23512138	One Gallon Jug — 6 Per Case
	23512139	55 Gallon Drum
	23512140	Bulk Delivery — 1,000 Gallon Min.
Pre-Blended 50:50	23518918	55 Gallon Drum
	23513503	Bulk Delivery — 1,000 Gallon Min.

POWER COOL ENGINE PRODUCTS (Cont.)

Table 22. <i>Power Cool</i> 2000 Supplemental Coolant Additive		
Coolant Type	Part Number	Description
For <i>Power Cool</i> IEG Coolant	23507858	Pint Bottle — 12 Per Case
	23507859	Half Gallon Jug — 6 Per Case
	23507860	5 Gallon Pail
	23507861	55 Gallon Drum

Table 23. <i>Power Cool</i> 3000 Supplemental Coolant Additive		
Coolant Type	Part Number	Description
For <i>Power Cool</i> IEG Coolant	23507854	Pint Bottle — 12 Per Case
	23507855	Half Gallon Jug — 6 Per Case
	23507856	5 Gallon Pail
	23507857	55 Gallon Drum

Table 24. <i>Power Cool</i> 3000 Supplemental Additive Coolant Filters		
Coolant Type	Part Number	Description
For <i>Power Cool</i> IEG Coolant	23507545	4 Ounce (1 Pint Equivalent)
	23508425	8 Ounce (2 Pint Equivalent)
	23508426	12 Ounce (3 Pint Equivalent)
	23507189	16 Ounce (4 Pint Equivalent)
	23508427	32 Ounce (8 Pint Equivalent)
	23508428	53 Ounce (13 Pint Equivalent)

Table 25. <i>Power Cool</i> Supplemental Additive Need Release Coolant Filters		
Coolant Type	Part Number	Description
For <i>Power Cool</i> IEG Coolant	23516488	For 0-8 Gallon Systems
	23516489	For 8-20 Gallon Systems

POWER COOL ENGINE PRODUCTS

Table 26 <i>Power Cool Plus</i> Extended Life NOAT Coolant		
Coolant Type	Part Number	Description
Concentrated	23519394	55 Gallon Drum
	23519395	Bulk Delivery — 1,000 Gallon Min.
Pre-Blended 50:50	23519396	One Gallon Jug — 6 Per Case
	23519398	55 Gallon Drum
	23519399	Bulk Delivery — 1,000 Gallon Min.

Table 27. <i>Power Cool Plus</i> Extender for Use with <i>Power Cool Plus</i> NOAT Coolant		
Coolant Type	Part Number	Description
For <i>Power Cool Plus</i>	23519400	One Quart Bottle — 6 Per Case

Table 28. <i>Power Cool Plus</i> 6000 OAT Inhibitor for Water-Only Systems		
Coolant Type	Part Number	Description
Water Only	23522127	One Gallon Jug — 6 Per Case
	23522128	5 Gallon Pail

POWER COOL ENGINE PRODUCTS

Table 29. Power Cool Cooling System Cleaners		
Cleaner Type	Part Number	Description
On-Line Cleaner	23507862	One-Half Gallon Jug — 6 Per Case
	23507863	5 Gallon Pail
	23507864	55 Gallon Drum
Twin Pack	23507867	Twin Pack — 2 Per Case

Table 30. Power Trac Coolant Testing & Analysis Products		
Application	Part Number	Description
Indicates Nitrite, Molybdate & Glycol Levels	23519401	3-Way Coolant Test Strips (Single Foil Packs)
Indicates Nitrite, Molybdate & Glycol Levels	23519402	3-Way Coolant Test Strips (Bottle of 50)
Indicates Nitrite, Molybdate & Glycol Levels	23522774	3-Way Coolant Test Strips (Bottle of 10)
Complete IG PG Coolant Analysis	23516921	Coolant Analysis Bottle (Carton of 6)
Complete NOAT Coolant Analysis	23523398	Coolant Analysis Bottle (Carton of 6)

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DETROIT DIESEL
CORPORATION



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